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The U.S. Fish Commission Steamer *Albatross*

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On the cover: The *Albatross*, ca. 1905. Photo by Asahel Curtis, courtesy of the Washington State Historical Society (Curtis negative number 6523).

Articles *61(4), 1999*

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The U.S. Fish Commission Steamer *Albatross*: A History

Papers from a Symposium

Introduction

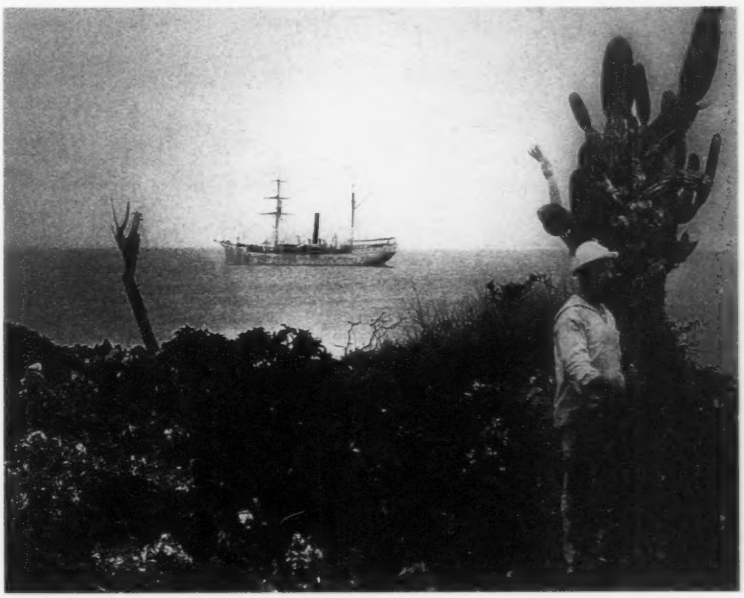
At her launch on 19 October 1882 in Wilmington, Del., the *Albatross* was the world's first large deep-sea oceanographic and fisheries research vessel, and she would go on to have a distinguished 40-year career, ranging from the north Atlantic Ocean to the Gulf of Mexico, around Cape Horn in 1887–88, and into the North Pacific.

By 1908, Deputy Fish Commissioner Hugh M. Smith reported that "The *Albatross* has contributed more to the knowledge of marine biology than has any other vessel." And, of course, her career continued for another 13 years, being decommissioned in late 1921, serving later as a training vessel for nautical cadets, and disappearing from the records in Hamburg, Germany, in late 1928.

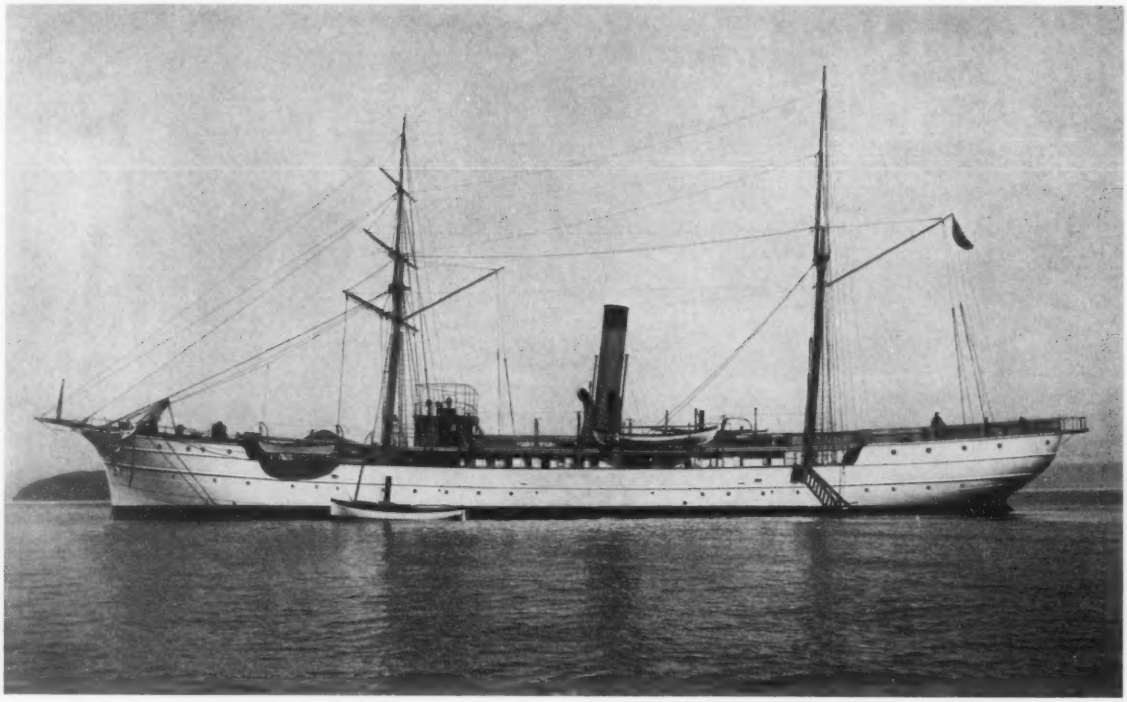
Besides her work in biological and physical oceanographic research, the *Albatross* served the United States during two wars, and in the North Pacific she mounted many seal protection cruises and Pacific salmon surveys, as well as carrying investigative commissions (two established by presidential order).

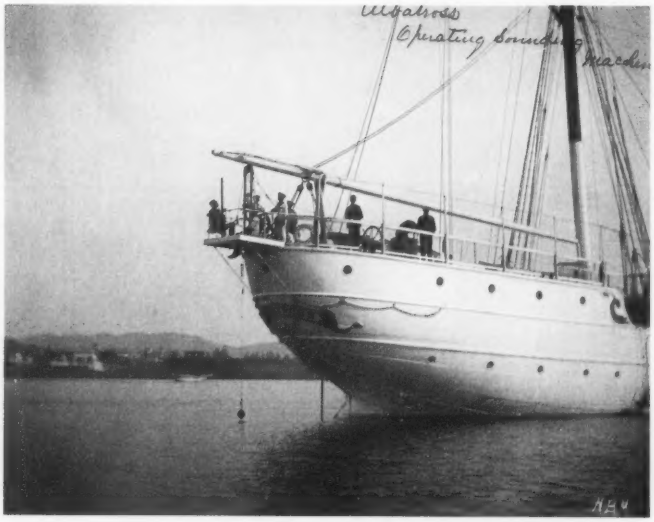
As scientist Charles H. Townsend reminisced in 1934, "Her career as a deep-sea exploring ship has been a notable one ... [that] extended from the shallow waters of the coast to almost the greatest known depths of the sea.... If ever the American people received the fullest possible value from a government ship, they received it from this one."

Much of the above, as well as the origin of the *Albatross*, was covered in a symposium held on 30 June 1997 at the University of Washington in Seattle. Organized by Mark Jennings and Kurt Dunbar, several papers from that symposium are presented in this special issue of the *Marine Fisheries Review*.



The *Albatross* in the Galapagos Islands, 1891. Reproduced with permission of the MCZ Archives.



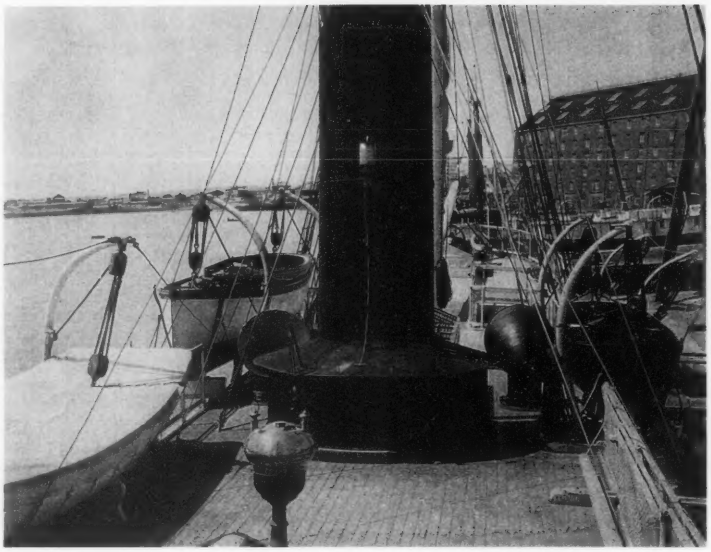


Above: The *Albatross* with a port gang plank down and one of her small steam-powered runabouts which was carried on the deck like the other boats and raised and lowered by winches. USFC photograph.

Left: The elegantly curved stern held the platform for a sounding machine, shown here in operation. NEFSC historical photograph archives.

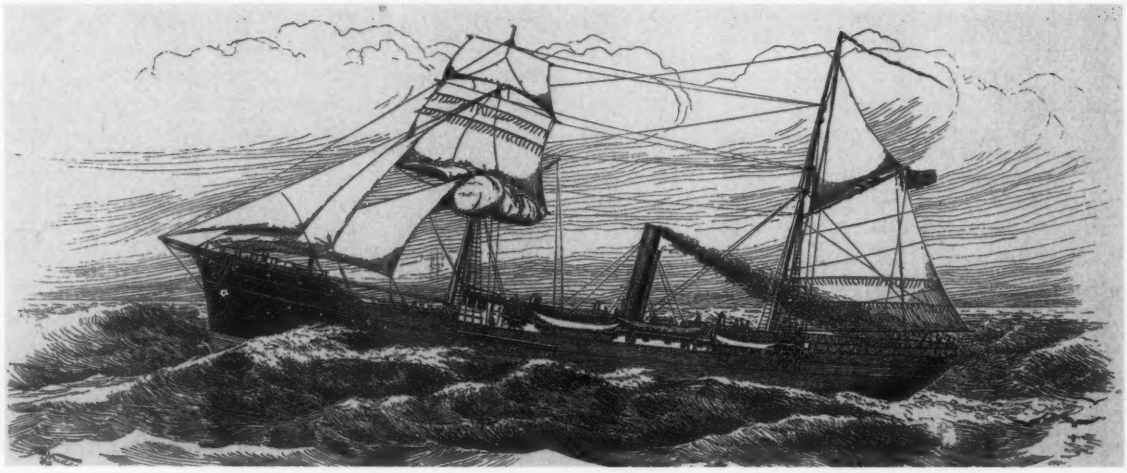
Above: A ship of the high latitudes as well as the equator, the *Albatross* dropped anchor in Southeast Alaska during a northern cruise. NEFSC historical photograph archives.

Right: At home in Woods Hole, the *Albatross* is seen from the USFC residence. NEFSC historical photograph archives.

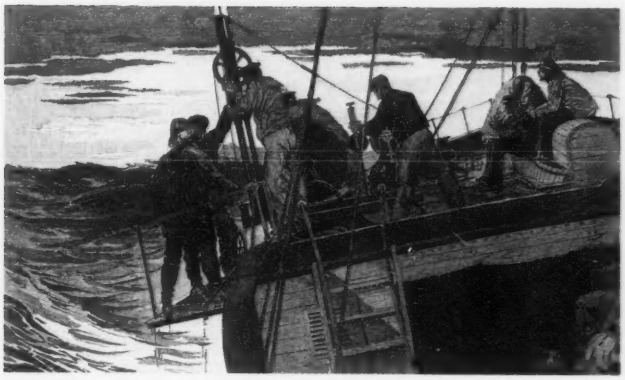


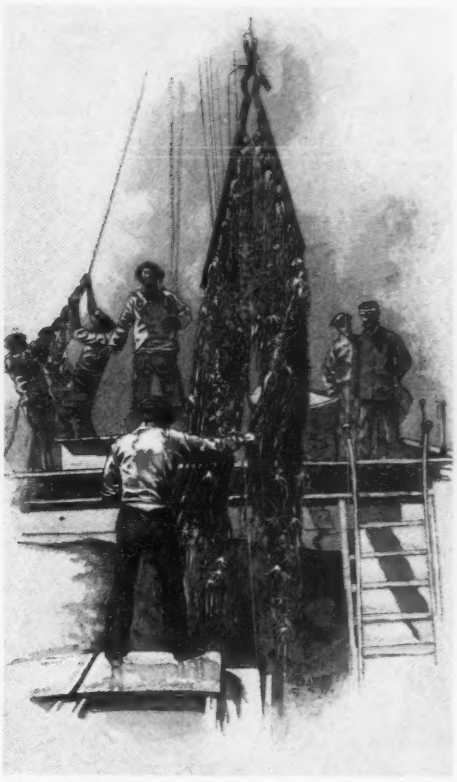
Left: The smoke stack at mid-ships. Although usually powered by her strong, twin-screw engines, the *Albatross* could sail if necessary. NEFSC historical photograph archives.

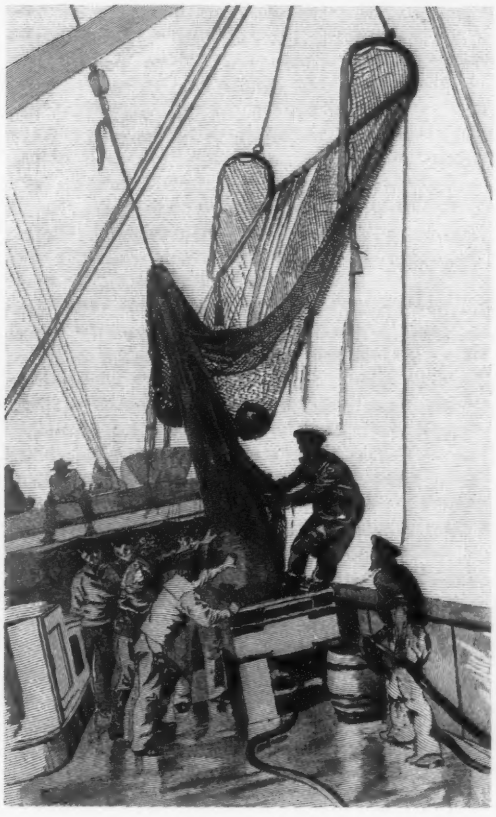
Below: Artist's rendition of the *Albatross* under steam and sail in heavy weather. Drawing is by C. B. Hudson in *The Century Magazine.*

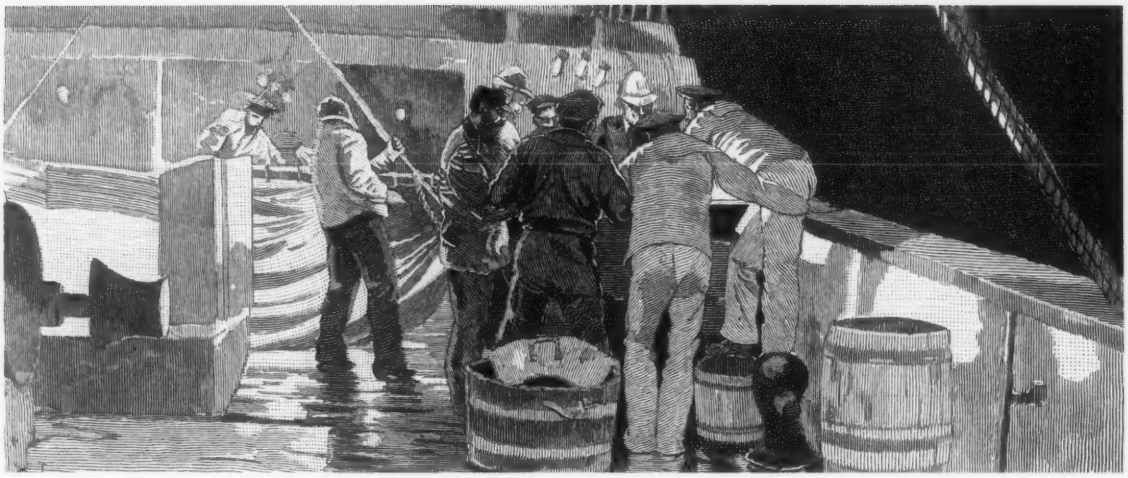


Opposite page: Working while the ship rocked on ocean swells was standard fare. Clockwise from upper left: "Sounding the abyss with piano wire;" "Tangles from the sea-lily grounds, Gulf of Mexico;" The deck and sounding equipment as depicted in action above; and "Landing the beam-trawl on deck." Drawings are by W. Taber in *The Century Magazine*; photograph is from the NEFSC historical photograph archives.

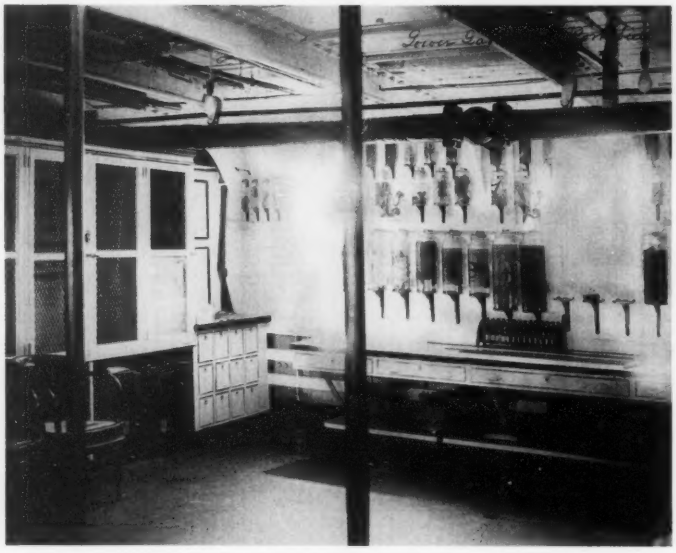






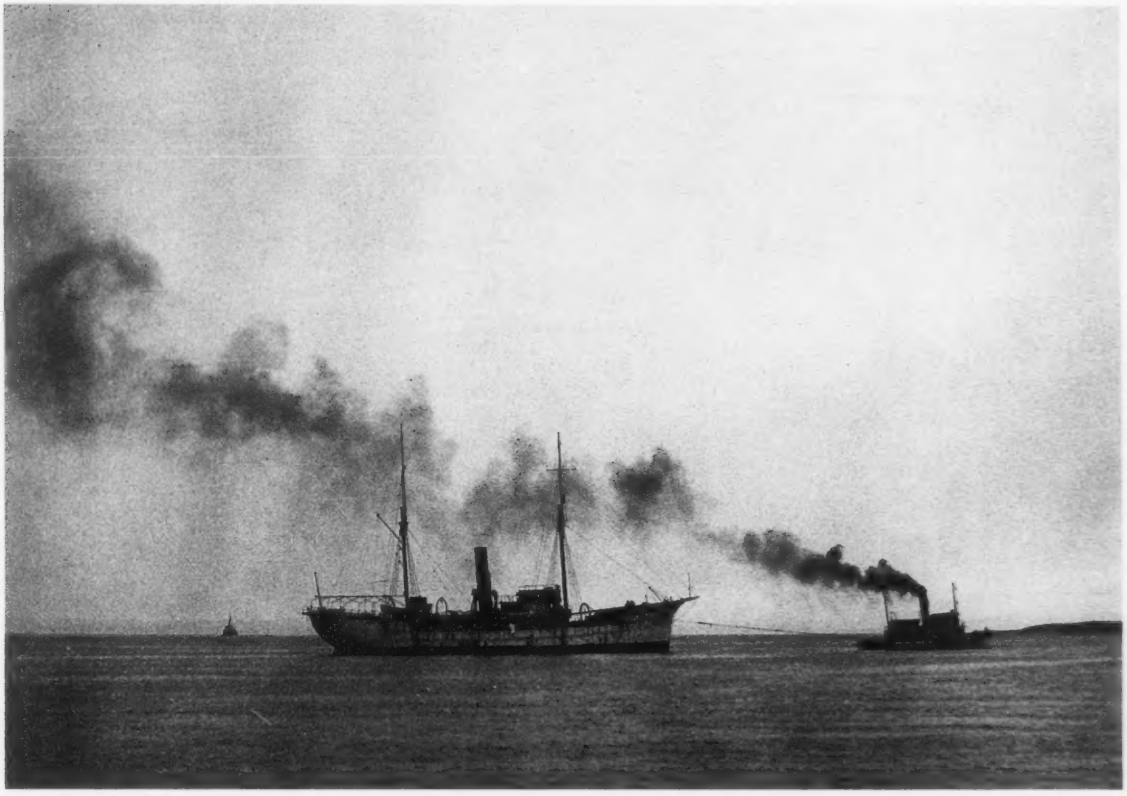


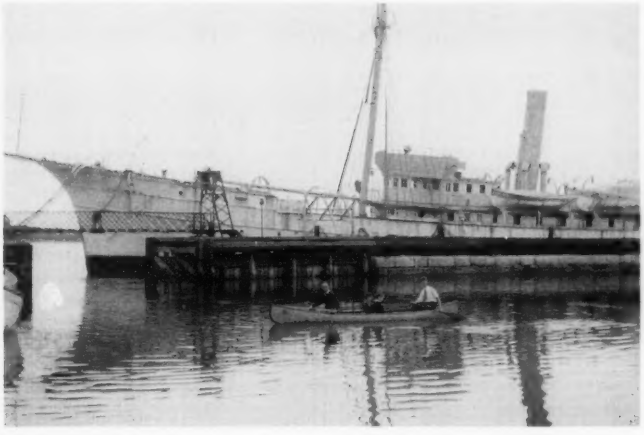
On deck, the men worked in the all kinds of weather, and are shown here examining the contents of a sieve by electric light. Drawn by W. Taber for *The Century Magazine.*



Below deck, the science room was a floating laboratory stocked with supplies and equipment. NEFSC historical photograph archives.

The mess. NEFSC historical photograph archives.





Upon decomissioning in 1920 after nearly 40 years of service, the *Albatross* had worked a full decade past her retirement date. Both images are from the NEFSC historical photograph archives.

The Origins and Early History of the Steamer *Albatross*, 1880–1887

DEAN C. ALLARD

Spencer Fullerton Baird (Fig. 1), a noted systematic zoologist and builder of scientific institutions in 19th century America, persuaded the U.S. Congress to establish the United States Commission of Fish and Fisheries[1] in March 1871. At that time, Baird was Assistant Secretary of the Smithsonian Institution. Following the death of Joseph Henry in 1878, he became head of the institution, a position he held until his own demise in 1887. In addition to his many duties as a Smithsonian official, including his prominent role in developing the Smithsonian's Federally funded National Museum as the repository for governmental scientific collections, Baird directed the Fish Commission from 1871 until 1887.

The Fish Commission's original mission was to determine the reasons and remedies for the apparent decline of American fisheries off southern New England as well as other parts of the United States. In 1872, Congress further directed the Commission to begin a large fish hatching program aimed at increasing the supply of American food fish.

Five years later, Baird served as the government's chief scientific witness during an international arbitration held at Halifax, Nova Scotia, Can., to determine how much the United States owed for the rights granted in the 1871 Treaty of Washington to fish in the territorial waters of Canada and Newfoundland. From the U.S. point of view, the $5.5 million award that the Halifax tribunal granted to Canada and Newfoundland was shockingly unjust and suggested that the fishing treaty should not be renewed when it expired in 1885. Another reaction was Spencer Baird's decision to initiate a Fish Commission program that gave direct aid to the nation's commercial fisheries, including efforts to locate new fishing grounds that were as far removed from British North America as possible (Goode, 1883:177–178; Allard, 1978:180–238).

While pursuing these utilitarian programs, Baird's Commission devoted each summer to basic biological and physical investigations of the northwest Atlantic. Initially, Baird's pioneering surveys concentrated on the coastal waters of New England. The village of Woods Hole, Mass., was the base for this work in 1871 and 1875 and in the years following 1881. But, during the first decade of the Commission's work, as Baird extended his investigation to cover most of New England's continental shelf, he established his laboratory at a number of other locations in the region, ranging from Noank, Conn., to Eastport, Maine.

Baird repeatedly argued that the basic knowledge accumulated through his investigations was essential for the solution of practical fishery problems (Allard, 1978:164–179). But some contemporary observers argued that scientific work, including the gathering of massive collections of specimens for Baird's National Museum in Washington, received undue emphasis by the Fish Commission (U.S. Congress, 1889:544–545, 655–656).

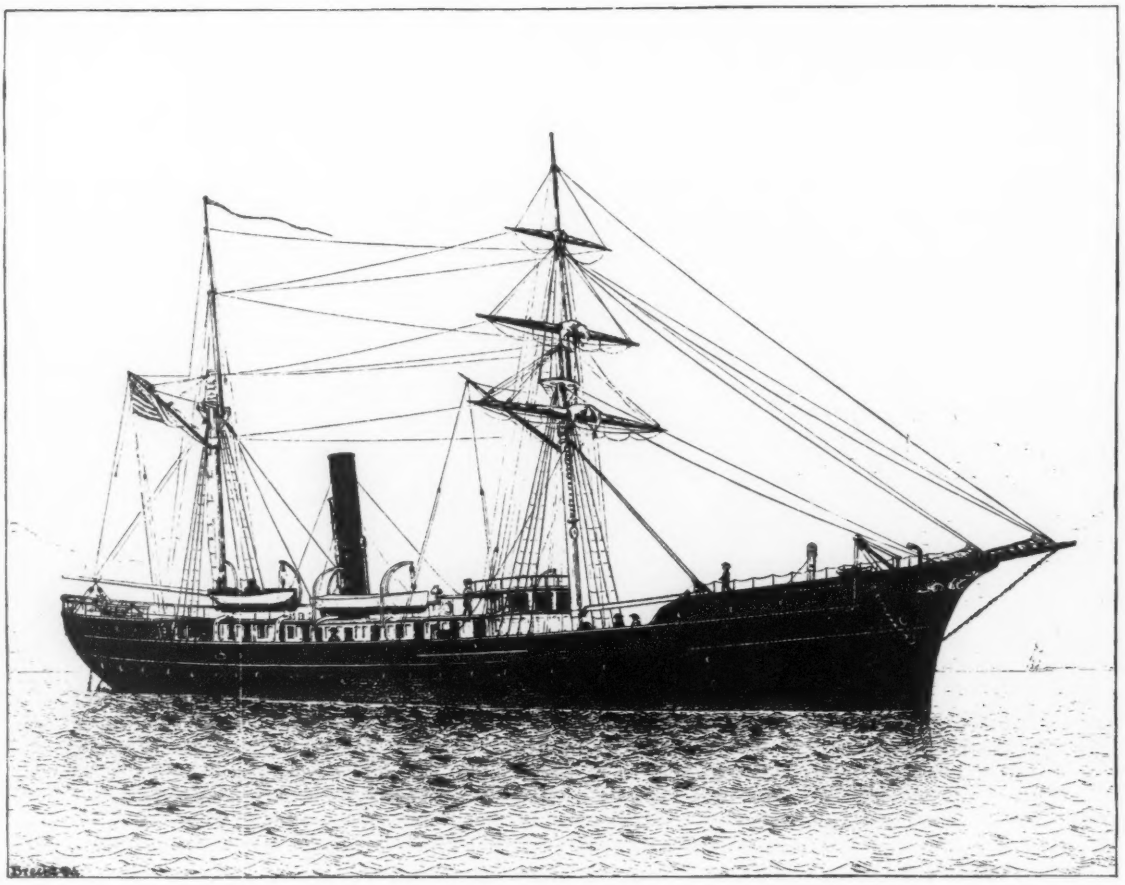
The objectives of the Fish Commission lay behind Spencer Baird's 1880 request to Congress for the ship that became known as *Albatross* (Fig. 2). American officials, still smarting from the Halifax award of 1877, recognized the importance of locating new banks and improving the productivity of existing grounds used by American fishermen. It is not surprising, therefore, that, in his initial lobbying with Congress, Baird stressed the need for a ship that could undertake exploratory fishing (USFC, 1884:xxiv).

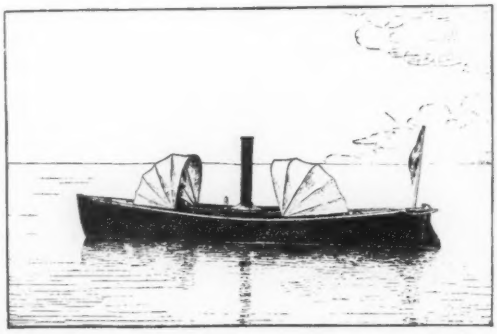
In addition, Baird very much had in mind the value of the *Albatross* in exploring the deep waters of the Northwest Atlantic where an exciting new frontier of scientific discovery beckoned (Fig. 3). Of initial interest was a region of relatively warm water on the edge

Figure 1.—Spencer F. Baird, founder and first Commissioner of the U.S. Commission of Fish and Fisheries and second Secretary of the Smithsonian Institution.

[1] Often referred to as the U.S. Fish Commission or just Fish Commission. For general accounts of Baird and the Fish Commission see Allard (1978), Dall (1915), Galtsoff (1962), and Rivinus and Youseff (1992).

Dean C. Allard, now retired, was head of the U.S. Navy History Center. Current address: 2701 North Quincy Street, Alexandria, VA 22207.





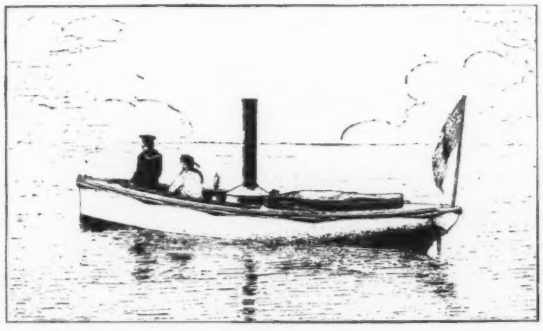


Figure 2.—A. The fisheries and oceanographic research steamer *Albatross*. B. The 25-foot Herreshoff steam gig. C. The 26.5-foot Herreshoff steam cutter. The *Albatross* also carried a 28-foot seine boat; a 26-foot whale boat; and an 18-foot, 2-inch dinghy.

of the Continental Shelf that the Fish Commission called the Gulf Stream Slope. The abyssal waters extending seaward of this area soon became another scientific target of the Fish Commission. Baird's new interests reflected the growing conviction by European and American scientists that the deep oceans contained an abundance of life.

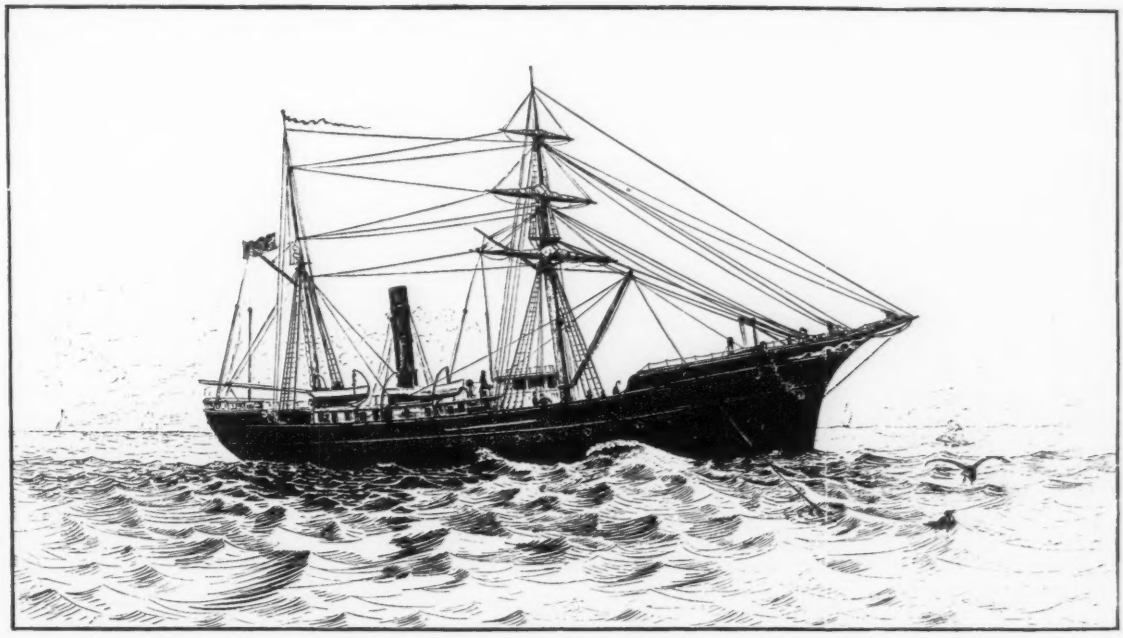


Figure 3.—The *Albatross* dredging.

Contributing to this belief was the material gathered during the round-the-world cruise of the British HMS *Challenger* in 1872–76.

During 1877–79, Alexander Agassiz made two cruises to the Caribbean and in 1880 one to Mid Atlantic and New England waters in the U.S. Coast Survey steamer *Blake*. Agassiz (1888) returned with valuable collections, some from as deep as 2,400 fathoms. During the same period, the *Speedwell*, a U.S. Naval ship assigned to Baird's Fish Commission, and the *Fish Hawk* (Fig. 4), a Commission hatchery vessel that could dredge in mid-depth waters, took rich hauls in the northwest Atlantic.

The excitement created by the fauna collected in 1877 from 144 fathoms by the *Speedwell*, at a point about 40 miles east of Cape Ann, Mass., was suggested by one of Baird's principal scientific assistants, George Brown Goode (Fig. 5). Goode exclaimed that "it seems incredible that American naturalists should not then have known that a few miles away there was a fauna as unlike that of our coast as could be found in the Indian Ocean or the seas of China[2]." Addison E. Verrill (Fig. 6), the Fish Commission's senior scientist, was equally impressed by the *Fish Hawk*'s collecting activity in 1880 in waters 100–500 fathoms deep and about 100 miles off Martha's Vineyard and Block Island. Verrill (1884:391) asserted that this area was "the richest and most remarkable ground ever discovered on our coast."

In 1881–82, Spencer Baird continued to use the *Fish Hawk* to dredge in waters as deep as 780 fathoms, primarily along the Gulf Stream Slope (Smith, 1888:915–932; Linton, 1915:741–744). But as soon as the *Fish Hawk*'s initial deep-sea work was completed in the fall of 1880, Baird decided to seek a far more capable research vessel. By December 1880 the Fish Commissioner could share his plans with Addison Verrill. Baird told his chief scientist that his new ship would have excellent laboratory spaces and scientific equipment, including "powerful hoisting engines" capable of working in waters as deep as 4,000 fathoms (Fig. 7). The Fish Commissioner specifically associated the *Albatross* with the exploration of the Gulf Stream Slope. As her later history revealed, however, the *Albatross* was equally capable of extended operations in any oceanic environment[3].

In his December 1880 letter to Verrill, the Fish Commissioner expressed pessimism that Congress would approve his proposal. Yet, despite his initial doubts, Baird mounted a skillful lobbying campaign that resulted in an 1881 Congressional appropriation for $103,000. By October 1881, Baird received the vessel's final plans from Charles W. Copeland, the New York City marine architect who had previously designed the Fish Commission's *Fish Hawk*. Bids

[2] Goode is quoted in Osborn (1901:22). For general background on deep-sea exploration in the 19th century, see Goode and Bean (1895:I, iii–viii) and Smith (1888:873–1017).

[3] Baird to Verrill, 7 Dec. 1880, USFC Letters Sent, Record Group 22, U.S. Natl. Archiv. A valuable overall source on the *Albatross* is Hedgpeth (1945) which includes a useful chronology prepared by Waldo L. Schmitt.

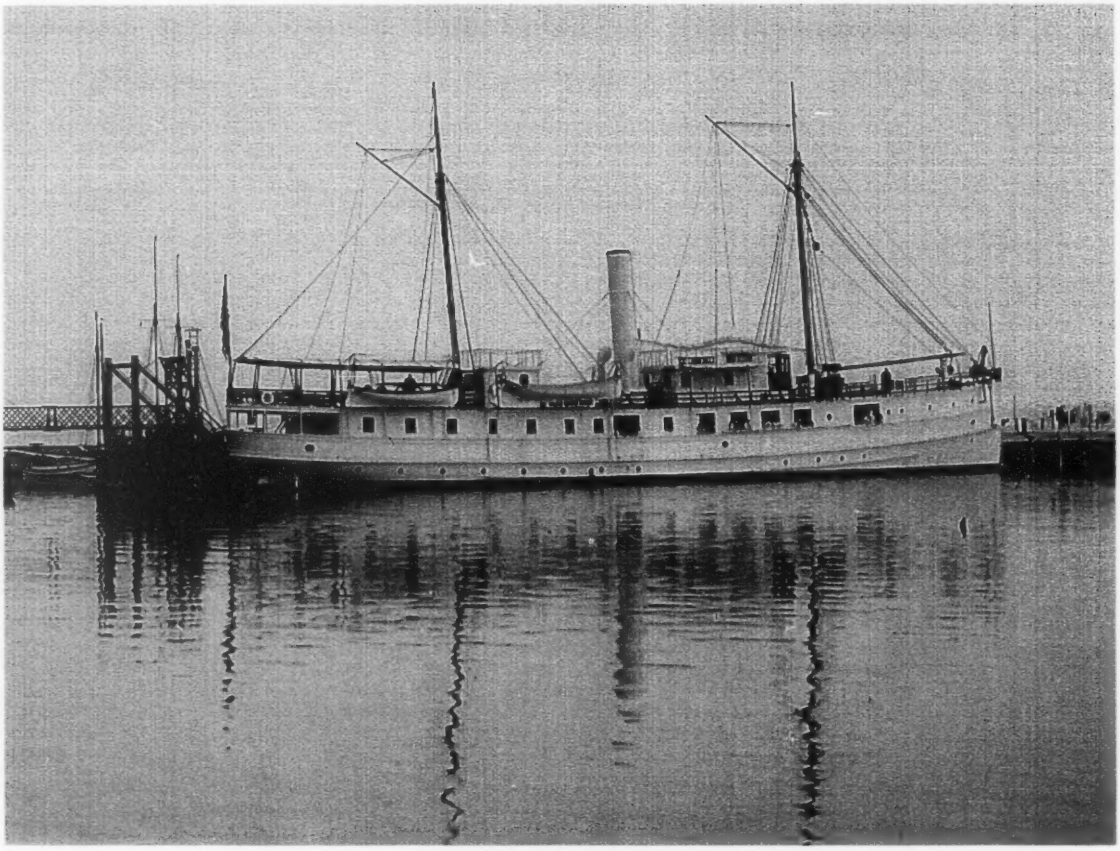


Figure 4.—The *Fish Hawk*.

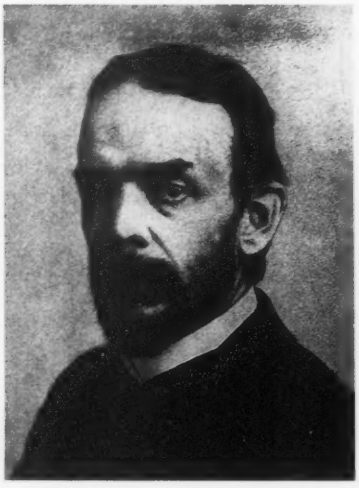


Figure 5.—George Brown Goode, an assistant to Baird.

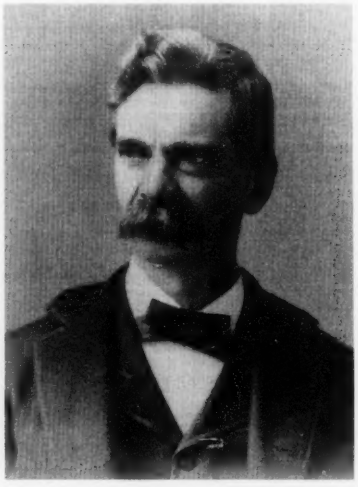


Figure 6.—Addison E. Verrill, a professor at Yale University.

then were requested from American shipbuilders. To Baird's profound disappointment, however, the lowest proposal received was for $129,500 (USFC, 1884:xxiv; Baird[4]).

Rejecting the option of using available funds to build a smaller vessel, the Fish Commissioner returned to Congress with a request for a supplemental appropriation. Pulling out all the stops, Baird listed six major contributions that *Albatross* could make to the nation:

1) Exploration and study of known fishing areas.
2) Location of new fishing grounds in the Atlantic, the Gulf of Mexico, and off the Pacific coast.

[4] Baird to Charles W. Copeland, 22 Oct. 1881, USFC Letters Sent, Record Group 22, U.S. Natl. Archiv.

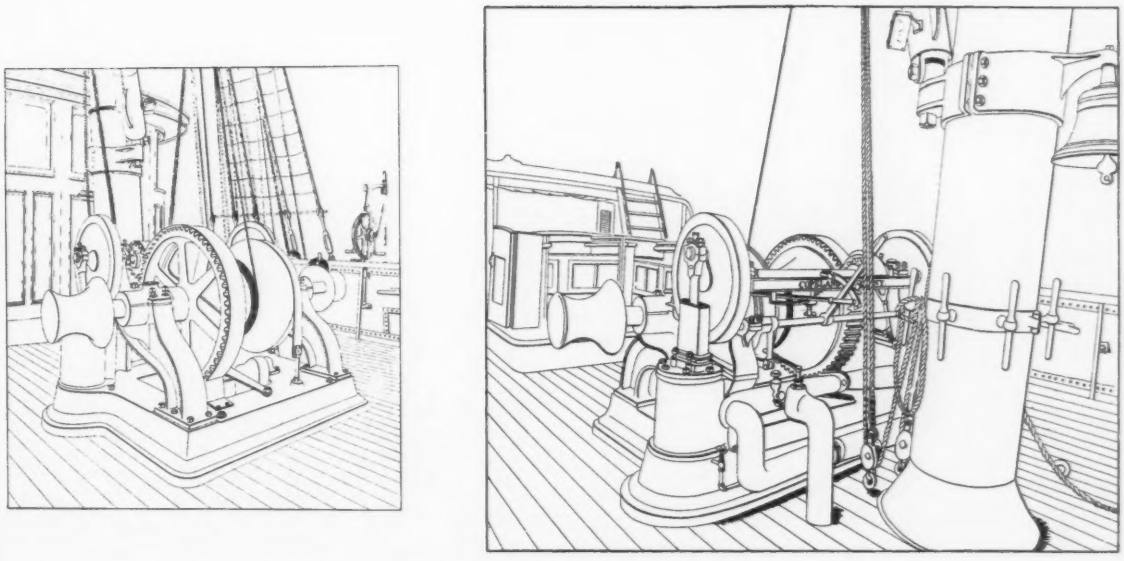


Figure 7.—The *Albatross* dredging engine views.

3) Major economic benefits would accrue to the nation's seafaring industry by increasing the yield of American fisheries.
4) The development of U.S. fisheries could make use of the British North American inshore fisheries unnecessary.
5) *Albatross* was a national security asset since, in case of need, she could be taken over by the Navy for use as a warship. In fact, this did occur during the Spanish American War and World War I.
6) And finally, Baird acknowledged his basic scientific interest when he stated: "As incidental to the economical inquiry, but of very great interest to the naturalist," the ship will collect "objects of natural history in large quantity otherwise unobtainable" (USFC, 1884a:xxv–xxxi).

In 1882 Congress once again granted Baird's request. In that year the Fish Commissioner not only received $42,000 in new funds for the ship, he also secured a $45,000 appropriation for the vessel's equipment. In all, a sum of $190,000 now was in hand to construct the *Albatross* (USFC, 1884b:xxvi–xxvii). Bearing in mind what this amount is worth in modern dollars, not to mention the great difficulty the U.S. Navy encountered during the early 1880's in obtaining appropriations for any new warship construction, one must be impressed by Baird's political skill in securing funding for the *Albatross*.

The Pusey and Jones Shipyard in Wilmington, Del., which previously built Baird's *Fish Hawk*, received the *Albatross* contract on 28 March 1882. Charles Copeland supervised the yard's work. He was assisted by Lieutenant Commander Zera L. Tanner, U.S. Navy, the prospective commander of the ship's Naval crew. That officer had considerable experience with marine exploration as the first commander of the *Fish Hawk* and through an earlier assignment with the Navy's Hydrographic Office.

Tanner was primarily responsible for selecting and installing—and in some cases personally designing—the trawl nets, rake and grapnel dredges, tangles, surface nets, and other collecting devices, as well as the ship's thermometers, salinometers, and sounding equipment (Fig. 8, 9) (Tanner, 1885; USFC, 1884b). According to Baird's associate, George Brown Goode (Goode and Bean, 1895: I,vi), the trawl nets carried by the *Albatross* were of particular importance since they represented a major advance in the ability to collect deep-sea specimens, a task previously undertaken with metal dredges.

Commissioned on 11 November 1882, the *Albatross* had her trial run from 30 December 1882 to 1 January 1883. She was the first large vessel specifically designed as a research vessel to be built anywhere in the world (Coker, 1949:43; Cotter, 1967:301). Writing in 1888, Alexander Agassiz (I, 51) noted another superlative of the ship. Pointing out that the vessel allowed the Fish Commission's exploration to extend "to the deepest waters along the American coast," Agassiz concluded that the *Albatross* was "the best equipped dredger for deep-sea work in existence."

The *Albatross* had an overall length of 234 feet, a maximum beam of 27.5 feet, and a displacement of 1,074 tons (Fig. 10). Her crew, minus the ship's scientific staff, numbered about 60 officers and men provided by the U.S. Navy. Constructed of wrought iron, the *Albatross* had twin screws and a maximum speed of 10 knots (Fig. 11). At her economical cruising speed of 8 knots, her maximum steaming radius was 3,200 miles. As was typical of oceanic ships

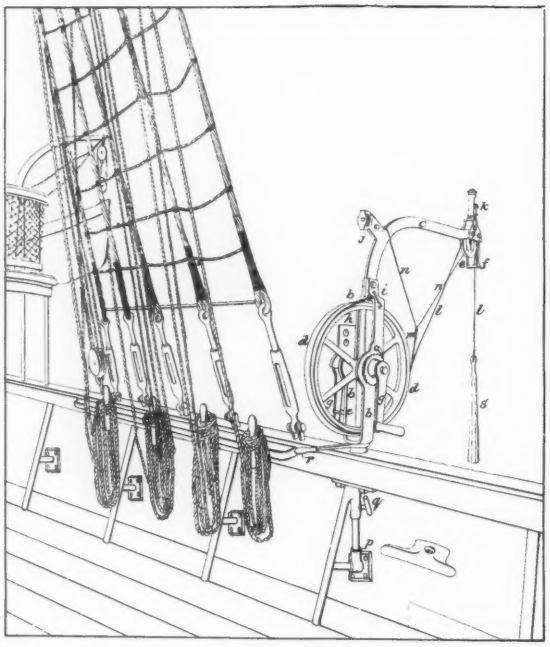


Figure 8.—The Tanner sounding machine.

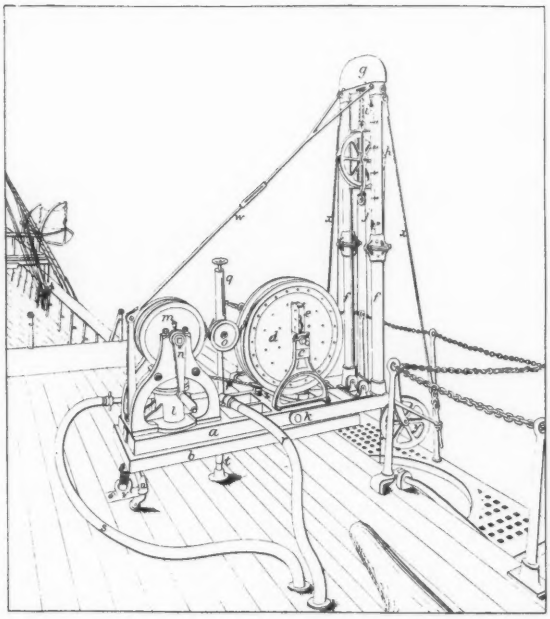


Figure 9.—Sigsbee's machine for sounding with wire, rigged for reeling in.

in an era when steam plants were still highly inefficient, she carried an auxiliary set of sails. The ship's deck logs show that sails were used frequently in the 1880's. In addition to her brigantine rig, a freshwater distilling plant allowed for prolonged maritime operations.

The *Albatross* had two relatively commodious laboratories (Fig. 12a, b, c), one on the main and the other on the berthing deck. She also had a pair of powerful dredging engines carrying 4,500 fathoms of 3/8-inch steel rope. Finally, her sponsors claimed that the ship was the first U.S. government vessel to be fully electrified (Fig. 13). This feature, as Lieutenant Commander Tanner pointed out, was especially important during prolonged deep-water dredging since these operations often could not be completed during daylight hours (Tanner, 1885:31–33; Tanner, 1895:107–124; Hedgpeth, 1945:6–8). Views of the cabin, chart room, pilot house, ward room, and berth deck are shown in Figures 14–18.

The *Albatross* began her distinguished career as a scientific vessel of the U.S. government—a history that would extend over the next 38 years—on 22 March 1883 when she established her first dredging station in 519 fathoms of water off the Mid Atlantic coast (Smith, 1889:934). As we know, many of the world's productive commercial fisheries are typically found in relatively shoal waters, rather than in the open ocean where this station was located. But, as previously noted, Baird made no secret of his desire to undertake a scientific survey of the ocean. He repeatedly argued that this knowledge was needed for its own sake, as well as for the understanding of commercial fishery issues. In addition to biological investigations, Baird recognized the importance of physical oceanography for both his applied and basic research programs. Hence, from the start, the *Albatross* took frequent soundings, tidal observations, bottom samples, temperature readings, and specific gravity and salinity measurements of the waters in which she operated (Schroeder, 1922: 160–161)

The *Albatross*'s primary mission during her first regular cruise in April 1883 was to study the movements of Atlantic mackerel, *Scomber scombrus*; Atlantic menhaden, *Brevoortia tyrannus*; bluefish, *Pomatomus saltatrix*; American shad, *Alosa sapidissima*; and other pelagic species during their spring migration northward of Cape Hatteras. At this time, the mackerel fishery had special importance[5] because of its great economic value and due to the fact that the mackerel was the major species caught by Americans in British North American waters under the controversial fishing treaty of 1871. But the mackerel was notorious, as Sabine (1853:184) commented, for being a "capricious and sportive fish, and continually changing its haunts and habits." Hence, any assistance that the *Albatross* could offer in locating schools of mackerel, particularly in U.S. or international waters, would be of value to American fishermen. The ship resumed her study of pelagic species in the fall of 1883 by attempting to track their southward mi-

[5] For the importance of the mackerel fishery see USFC (1884:xxv–xxxi).

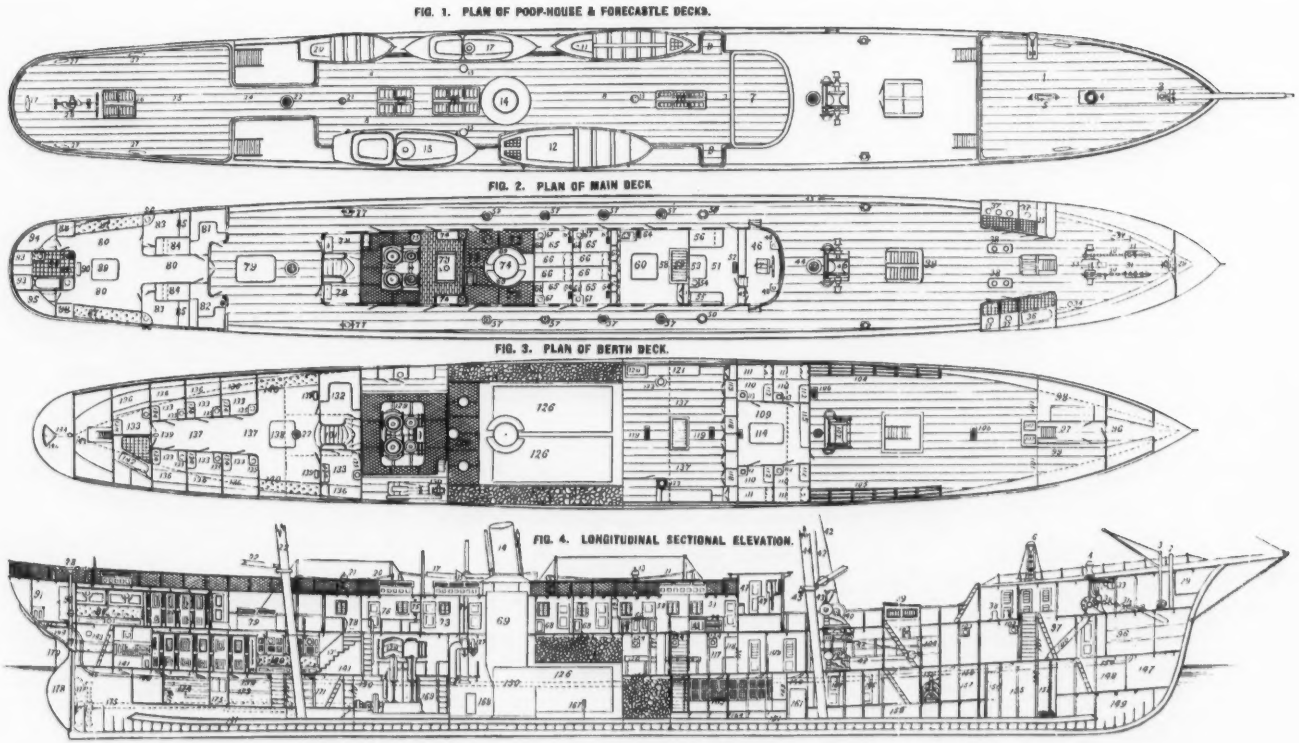


Figure 10.—Plans of the *Albatross*.

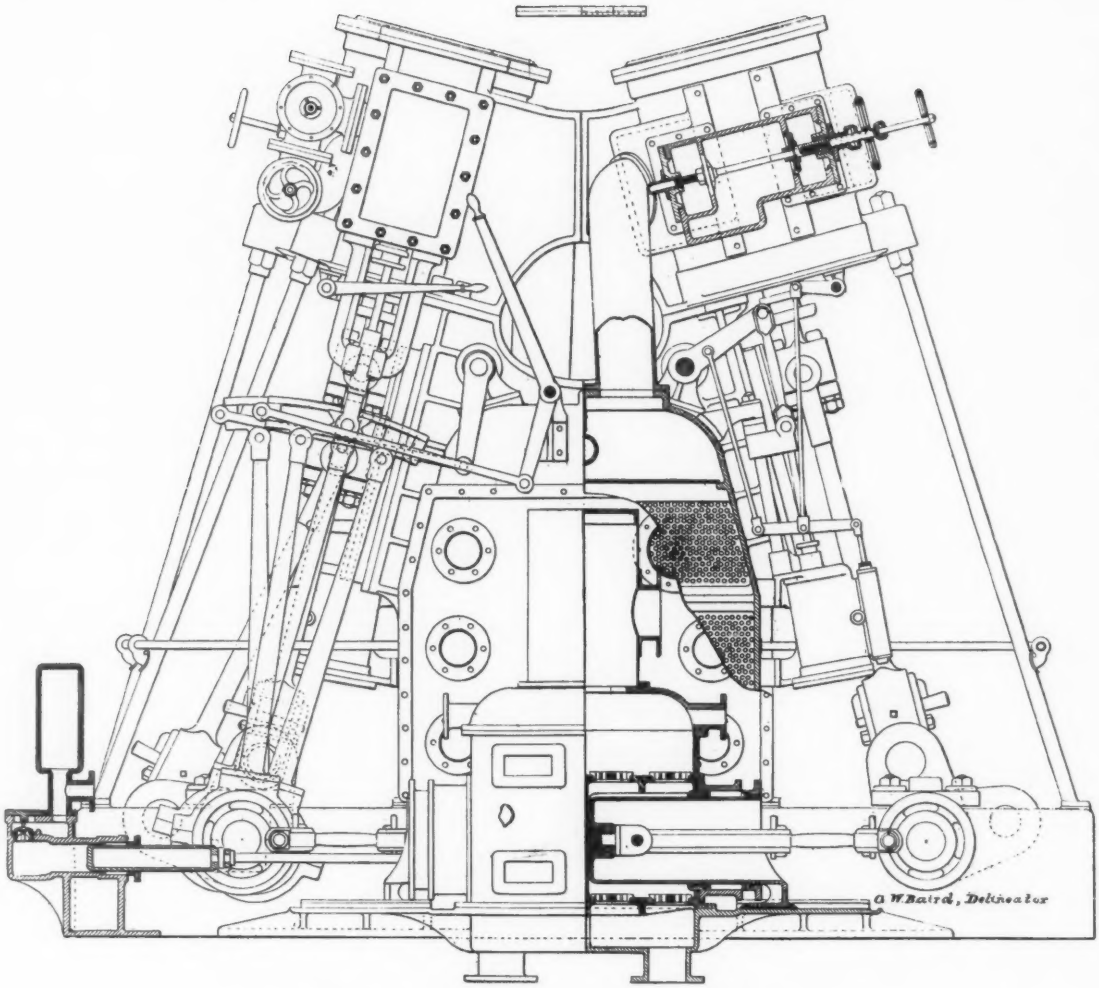


Figure 11.—Compound twin-screw engines of the *Albatross*.

gration from New England to the point where they disappeared for the winter in the deep waters off Cape Hatteras (Tanner, 1885:119–120, 154–165).

Another applied program of the ship was its effort to rediscover the tilefish, *Lopholatilus chamaeleonticeps*. In 1879, this previously unknown species was discovered by a Gloucester fishing captain in relatively warm New England waters 60–150 fathoms deep along the inside edge of the Gulf Stream Slope. Baird[6] once expressed private reservations about the taste of the tilefish, but, nevertheless, he and his Fish Commission colleagues touted it as a valuable food species comparable in quality to the Atlantic cod, *Gadus morhua*. Baird also asserted that the appearance of the tilefish demonstrated the value of exploratory fishing.

However, during the spring of 1882 there was a massive die-off of this species, apparently due to the intrusion of cold water into its grounds as the Gulf Stream slightly shifted its course. It was not until the early 1890's that the tilefish reappeared (Bumpus, 1899). Fortuitously, the tilefish grounds were in the Gulf Stream Slope region that was of so much basic scientific interest to Baird and his associates. After 1882 Baird could state that, in addition to his scientific agenda, the Fish Commission's investigations of that area were an attempt to relocate a valuable commercial species or at least to understand the reasons for the tilefish's disappearance (Bumpus, 1899:321–333; Herdman, 1923:178–181).

During the summer of 1883, the *Albatross* moved her base to Woods Hole. The ship's deployments from that port

[6] Baird to E. G. Blackford, 1 Sept. 1881, USFC Letters Sent, Record Group 22, U.S. Natl. Archiv.

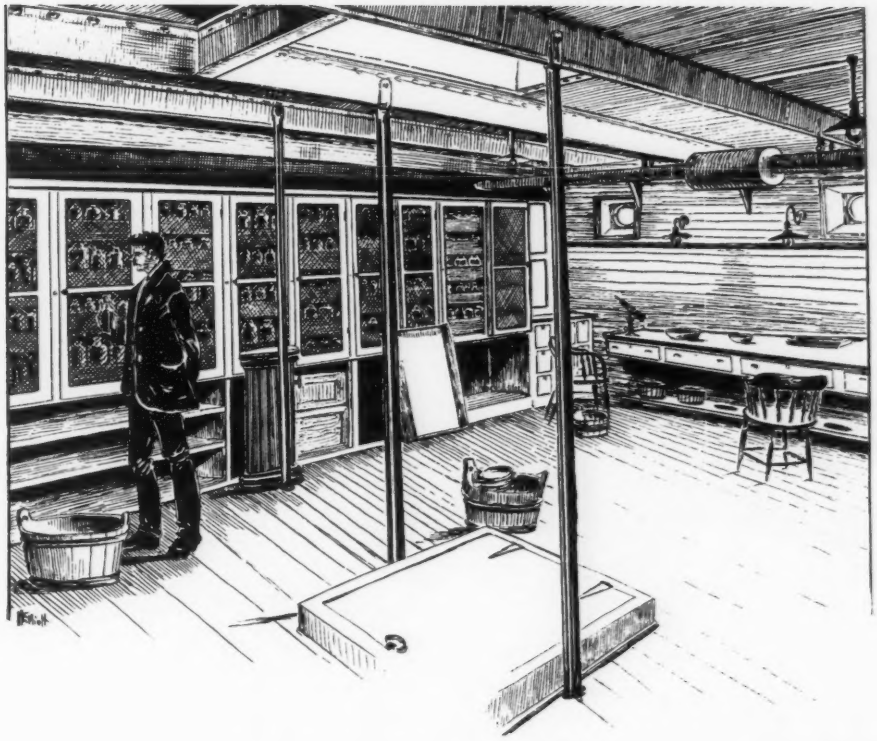


Figure 12a.—Lower laboratory, looking from aft forward.

revealed the fascination that the Gulf Stream Slope and the adjacent oceanic abyss held for the Fish Commission's scientists. In July, during the *Albatross*'s first cruise of the summer, the investigators on board included Edwin Linton, a young specialist in marine parasites. Linton gave a dramatic description of a night scene on the stern of the *Albatross* as the first trawl, which had been in the water for 6 hours, was hauled in from a depth of 1,400 fathoms under the illumination of the ship's electric lights.

None of the scientists present had seen deep-sea fauna, and they strained their eyes to detect the moment when the *Albatross*'s trawl broke the ocean's surface. Looking back many years after this event, Linton (1915:745–746) waxed poetic by suggesting that the surrounding darkness of that evening symbolized the profound ignorance of oceanic fauna that the light of science was seeking to dispel. Linton acknowledged that the net held only a relatively few forms. But, the naturalists present were profoundly impressed by the novelty of each species brought on board.

During this cruise the *Albatross* also established her deepest dredging station in the Atlantic phase of her career. The ship's record of 2,949 fathoms was set on 2 October 1883, several hundred miles off the Mid Atlantic coast in lat. 37°12″N, long. 69°39′W. (Smith, 1889:936).

In 1883, the senior scientist at the Commission's summer laboratory in Woods Hole continued to be Addison Verrill. Other investigators included Verrill's brother-in-law Sydney I. Smith, a specialist in crustaceans and Verrill's fellow professor at Yale. Richard Rathbun, the chief curator for marine invertebrates at the National Museum, assisted Verrill in directing the Fish Commission's laboratory. The Fish Commission's embryologist, John Ryder, and Theodore Gill, a Washington-based ichthyologist, also were on hand. The permanent naturalist on board the *Albatross* was James E. Benedict. During the ship's research cruises, he typically was joined by other younger men including Edwin Linton, Sanderson Smith, Peter Parker, and Willard Nye.

The more senior members of the scientific corps tended to stay ashore at the Fish Commission's laboratory instead of going to sea with *Albatross*. But the specimens on which they based their work were collected by that ship and other Fish Commission vessels. Master sets of these governmental collections were destined for the Smithsonian's National Museum after being scientifically worked up by their assigned investigators. In addition, hundreds of duplicates were donated to American schools and museums in order to promote the study of marine biology, or they were traded with other museums[7] for desired scientific materials (Hedgpeth, 1945:16–17; Allard, 1978:329–338).

[7] For examples of Baird's extensive trading activities with other museums, see Baird to C. Lutken (Royal Zoological Museum, Copenhagen), 14 Feb. 1887; and Baird to E. Frey (Swiss Minister to the United States), 8 Mar. 1887, both in USFC Letters Sent, Record Group 22, U.S. Natl. Archiv.

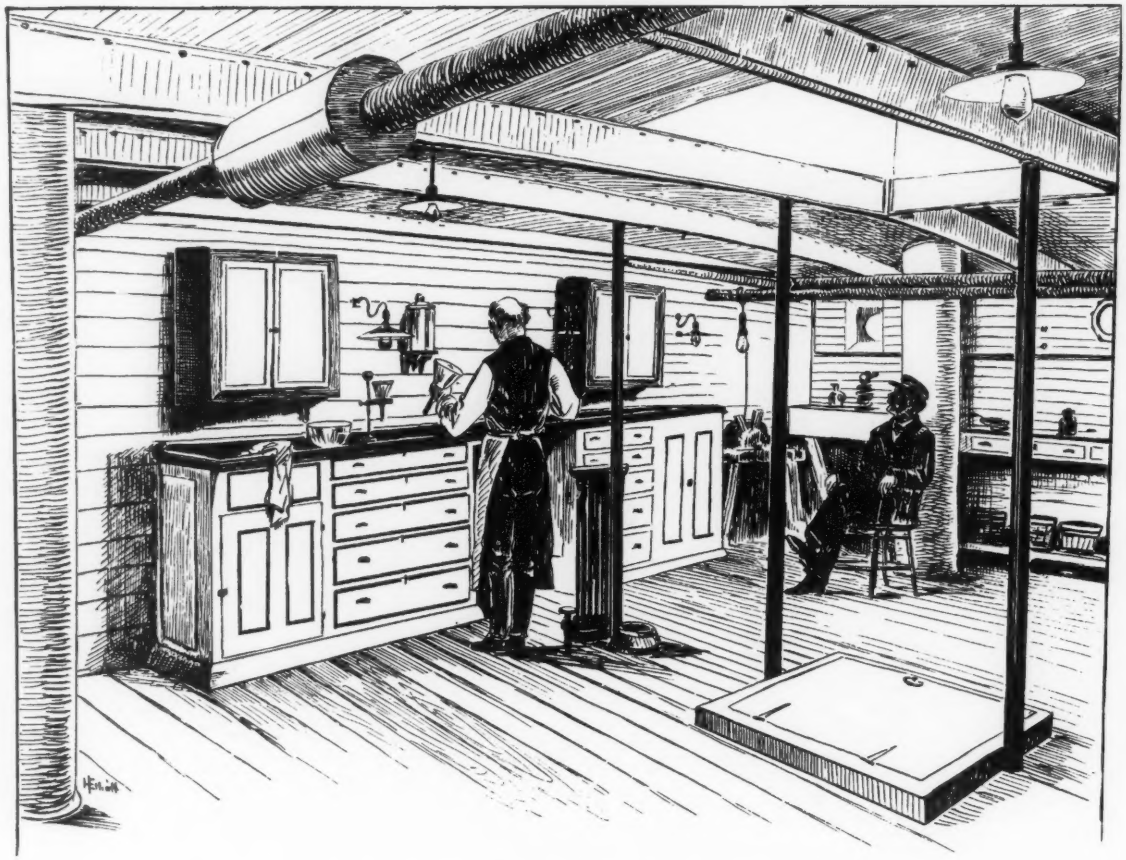


Figure 12b.—Lower laboratory, looking from forward aft.

The ship's association with Woods Hole was a consequence of Baird's decision in 1881 to locate his permanent field laboratory at that location. There were several reasons for Baird's choice. A base in southern New England was desirable because of its proximity to major fishing grounds. Baird also chose Woods Hole due to its relatively deep Great Harbor anchorage, the purity of the water in the Vineyard Sound–Buzzards Bay region, and the diversity of the fauna and flora that scientists could collect from the immediate region (Allard, 1978:329–338).

The Fish Commission's development of the Woods Hole station demonstrated once again Baird's ability to persuade Congress to fund major scientific initiatives. Overcoming the low priority that the Secretary of War assigned to the harbor improvements associated with his project, Baird obtained a March 1882 appropriation of $52,000 for the construction of piers, breakwaters, and other civil works needed for the Fish Commission's ships and for the operation of its hatchery and research programs. Between 1883 and 1885 he received additional appropriated funds in the amount of $65,000 earmarked for the construction of two buildings at Woods Hole. One contained biological and chemical laboratories and a fish hatchery, while the other structure was the residence and mess for his scientific corps (Fig. 19). Before these facilities were completed in 1884–85, the Fish Commission operated from a converted U.S. Lighthouse Board building on the shore of Woods Hole's Little Harbor that had been used since the Fish Commission began its work in 1871[8].

During the winter and spring of 1884, Baird loaned the *Albatross* to the U.S. Navy to undertake hydrographic surveys in the Caribbean Sea. These investigations confirmed the existence of a suspected underwater ridge stretching between St. Croix in the Virgin Islands and Puerto Rico, and located an extensive shoal (promptly named the Albatross Bank) east of Jamaica (U.S. Navy,

[8] The Secretary of War's position is indicated in Baird to Congressman S. J. R. McMillan, 8 Jan. 1883, USFC Letters Sent, Record Group 22, U.S. Natl. Archiv. For the development of the Woods Hole station see Allard (1978:321–323).

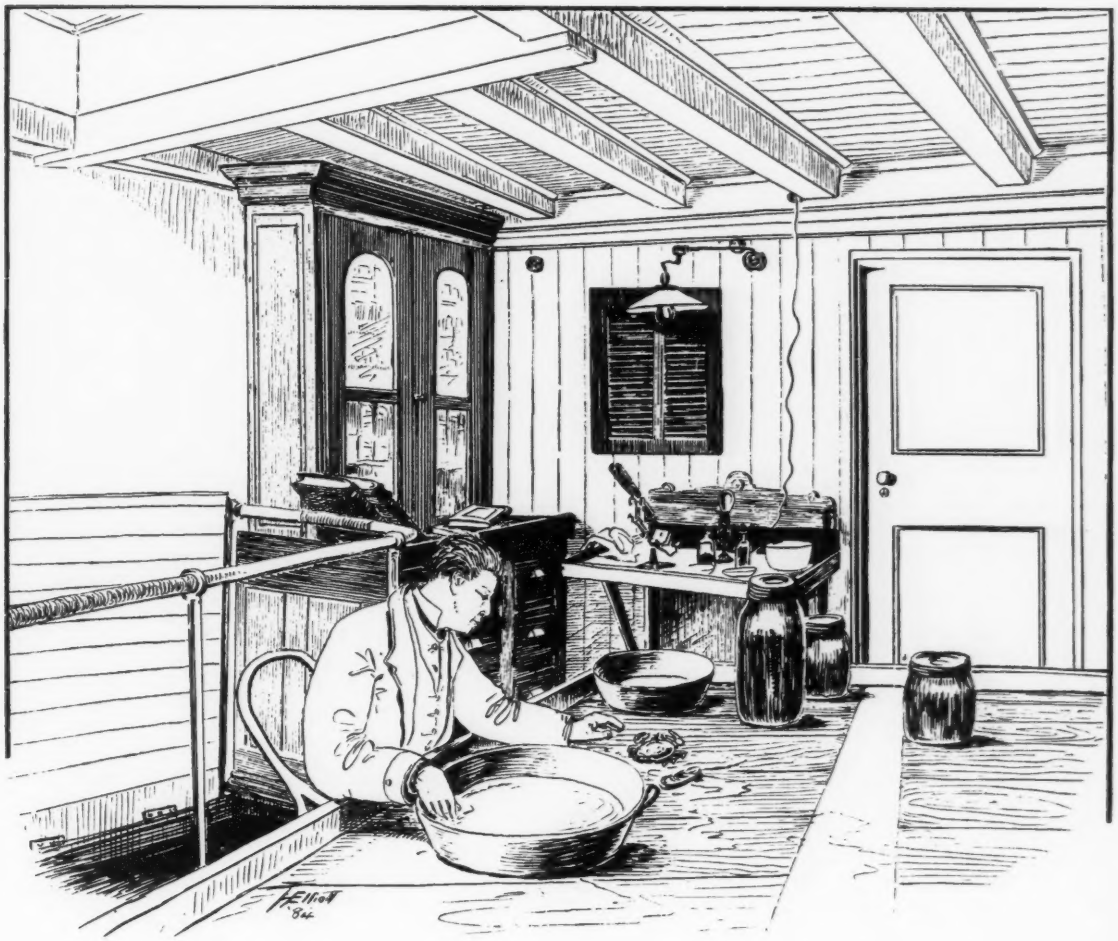


Figure 12c.–The upper laboratory.

1884:146–147). Equally important, according to the ship's navigator, these investigations proved the "non-existence" of a number of shoals reported by other mariners in this area (Smith, 1889:937). During the cruise, the ship's crew also had the secondary mission of collecting biological specimens. Then, from late July to early October of 1884, the ship proceeded to her summer base at Woods Hole. While en route to that location, the ship once again sought to trace the movements of pelagic species between Cape Hatteras and the Gulf of Maine.

But the focus of the *Albatross*'s summer activities was in the deep waters of the northwest Atlantic. Here, collections and data were obtained from waters as deep as 2,600 fathoms off the coasts of New England, Long Island, and New Jersey. Although Baird continued to observe that one of his purposes was to search for the tilefish along the Gulf Stream Slope, the fundamental contribution made by these oceanic operations was the illumination of the biological and physical characteristics of the deep-ocean environment (Tanner, 1886:78–79; USFC, 1886:xviii;xx)[9].

By this time, work was underway on two important research projects that used many of the materials gathered by the *Albatross*. One was the effort by Addison Verrill and his associates to study deep-sea invertebrates. Eventually this group published more than 100 papers, most of which appeared after Verrill ended his connection with the Fish Commission following Baird's

[9] Another basic source for the *Albatross*'s operations is the ship's deck log, 1 Jan. 1884 through Dec. 1887 (the author has not located earlier deck logs) held in Record Group 24, U.S. National Archives. Record Unit 7184 in the Smithsonian Institution Archives contains some of the ship's scientific logs for the 1880's. Periodic reports to Baird in 1883 and 1885, from James E. Benedict, the ship's resident naturalist, are in the Smithsonian's Record Unit 7438.

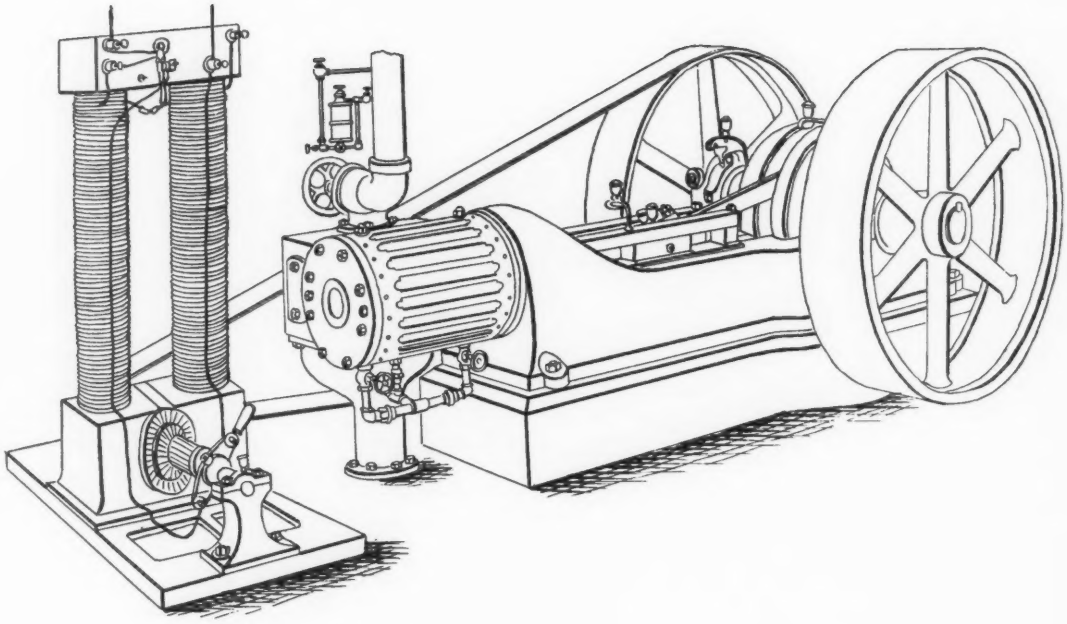


Figure 13.—The Edison dynamo and Armington & Sims engine.

death in 1887 (Schopf, 1968:F5–F10; Allard, 1978:337–338). The second undertaking was a two-volume work entitled "Oceanic Ichthyology," published by the Fish Commission and authored by George Brown Goode and Tarleton H. Bean (1895), two of Baird's associates at the National Museum.

Goode and Bean acknowledged the utility of the deep-sea specimens that Alexander Agassiz assigned to them after collecting these materials during the *Blake*'s 1880 cruise north of Cape Hatteras (Agassiz, 1888:I, xx). But they noted that their work rested primarily on specimens collected by the *Albatross*, supplemented by those from other Fish Commission ships and by Gloucester fishermen.

It is of interest that Goode and Bean (1895) questioned the scientific importance often ascribed to the famed cruise of the *Challenger* in 1872–76 (Allard, 1978:338–339). In the front matter to "Oceanic Ichthyology" they claimed that the 47 new genera and 147 new species of deep-water fishes described in their work were more numerous than all of the oceanic fishes collected by the *Challenger* during that ship's entire world cruise (Goode and Bean, 1895:I, v–vi).

Tensions between naval crews and ocean scientists that so often appear in the annals of oceanic exploration (the United States Exploring Expedition of 1839–42, commanded by the naval officer Charles Wilkes (Stanton, 1975), comes to mind[10]) seem to have been largely absent from the *Albatross*. Much of the credit for this happy situation needs to go to Lieutenant Commander Zera L. Tanner, who remained in command of the ship from 1882 to 1894. He was admired by the Fish Commission's staff as a bluff, ruddy-faced skipper who ran a taut but fair ship (Linton, 1915:749; Young, 1922:364–365). Tanner's fellow naval officer, Seaton Schroeder, the *Albatross*'s executive officer and navigator from 1882 to 1885, also commented on his captain's character by describing him as a "consummate seaman" with "a remarkable insight and balanced judgment regarding both men and things, coupled with an iron nerve and decisiveness" (Schroeder, 1922:160).

Tanner's marine skills were especially required when the ship deployed its large trawl nets in deep waters. During these operations, a constant strain needed to be maintained in order to prevent the trawl's steel cable from parting during the four or more hours required to complete a deep-water operation (Washburn, 1886:20–21). One *Albatross* scientist later claimed that Tanner never severed a dredge line (Townsend, 1924:620). But this is an exaggeration since, on at least one occasion in August 1885, the cable did part, resulting in the loss of more than 3,000 fathoms of wire rope plus the entire beam-trawl assemblage. On other occasions, trawl nets came up empty due to the failure of *Albatross*'s crew to place these devices on the ocean floor[11].

[10] Another example of commanding officer-scientist acrimony was the conflict in 1902 between a later commander of the *Albatross* (Chauncy Thomas, Jr.) and the naturalist Charles Henry Gilbert, as reviewed by Dunn, 1996.

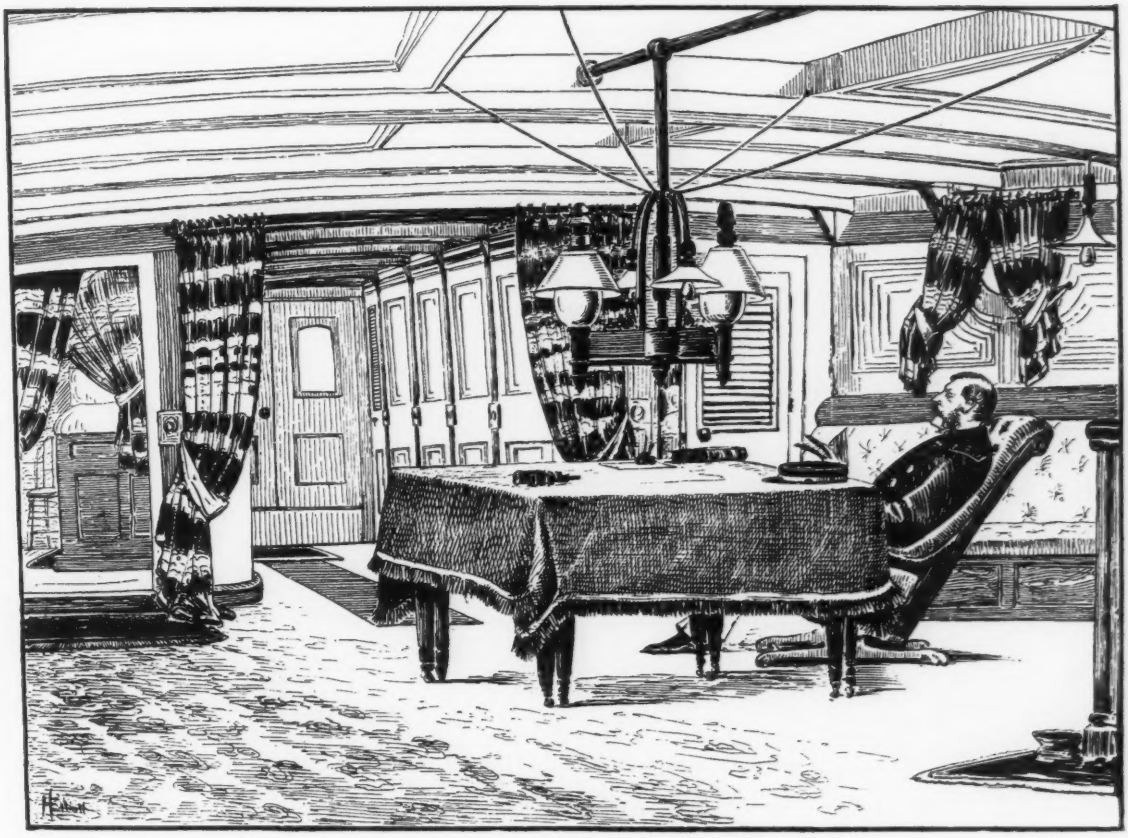


Figure 14.—The cabin.

Nevertheless, there is no doubt that the captain and his crew had notable operational skills. Tanner, himself, generously gave much credit for this situation to the vessel herself. He once described *Albatross* as having special strength and sea-worthiness; the ability to "lay-to" in heavy seas, while recovering its scientific gear, without shipping water over the bow or stern; and having an "easy motion under all circumstances [that] was necessary to the safety of the steel-wire dredge rope" (Tanner, 1895:117; Schroeder, 1922:165–166) (Fig. 20).

At the same time, it must be acknowledged that the *Albatross* had one major operational problem. Almost from the time of the ship's commissioning, it became clear that the ship's boilers were faulty. By 1884, the ship's engineer, Passed Assistant Engineer George W. Baird, U.S. Navy, reported that metal fatigue was the culprit for the many boiler leaks that required the crew to make almost constant repairs[12].

The *Albatross* began her third year of operation in January 1885 when she sailed from the Washington Navy Yard for a winter cruise in the Caribbean Sea. As was typical, Baird's letter of instruction to Tanner directed that he combine practical with scientific work[13]. Initially the ship collected specimens and hydrographic data off Cuba, Mexico's Yucatan Peninsula, and the U.S. Gulf coast. Then, the ship proceeded to an International Exposition in New Orleans, La., where many visitors came on board. Additionally, in another effort by the Fish Commission to expand American fisheries, the *Albatross* surveyed known fishing grounds and located a productive, new red snapper bank near Cape San Blas on the west coast of Florida (Tanner, 1887:3–26; USFC, 1887:xxvi–xxviii; Schroeder, 1922:166–167).

[11] *Albatross* Deck Logs, 30 Aug. 1885 and 22 Aug. 1886, Record Group 24, U.S. Natl. Archiv.

[12] Tanner's annual reports (USFC, 1884–87) often included separate accounts by Engineer Baird. There was no family relationship between this naval officer and Spencer Baird, according to Linton (1927:10).

[13] Baird to Tanner, 9 Dec. 1884, USFC Letters Sent, Record Group 22, U.S. Natl. Archiv.

Figure 15.—The chart room.

Following a now-familiar pattern, the *Albatross* deployed for the summer of 1885 in northern waters, using Woods Hole as her base. Initially the ship cruised in the Grand Banks region collecting hydrographic data for a new contour map of those highly productive fishing banks. Joseph W. Collins, the Commission's commercial fishing expert, personally directed this work. Later, the vessel operated in deep oceanic waters off the Continental Shelf.

Fish Commission spokesmen continued to state that the *Albatross* was searching for the tilefish, but this was not Baird's only motivation. During one of her cruises out of Woods Hole, the ship logged 11 deep-water stations with an average depth of 1,923 fathoms, yielding numerous bottom specimens. As was typical in *Albatross* operations during this period, plankton also was collected by surface nets, continual hydrographic observations were made, and readings were obtained of the ocean's specific gravity, salinity, and temperature. In addition to the scientists named previously, the Fish Commission's investigators during the summer of 1885 included Leslie A. Lee, a naturalist from Bowdoin College, and William Libbey, Jr., a Princeton physical oceanographer (Tanner, 1887: 27–62; NCAB, 1931:140–141; Deck Log[14]).

On her return to Washington, D.C., in October 1885, the *Albatross* undertook a limited investigation of the Gulf Stream region off the Delaware and

[14] *Albatross* Deck Log, June–Oct. 1885, Record Group 24, U.S. Natl. Archiv.

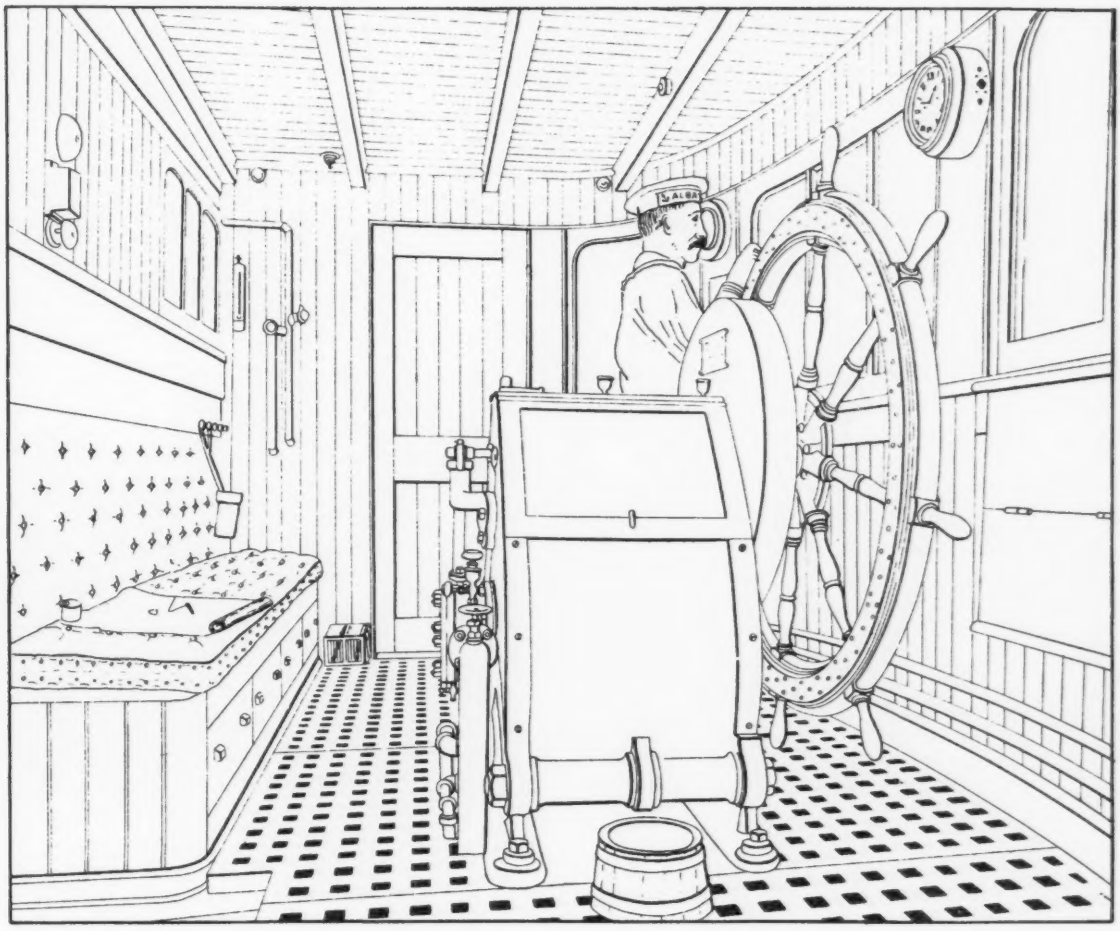


Figure 16.—Interior of the pilot house, steam steering room.

Chesapeake Capes and Cape Hatteras[15]. Aside from its scientific purpose, this activity probably was associated with Baird's interest in the spring and fall migrations of coastal pelagic species. Nevertheless, a later Congressional investigation of the Fish Commission alleged that Spencer Baird never "thoroughly planned" an inquiry into this subject (U.S. Congress, 1891:70–71).

The ship's 1886 winter cruise was funded jointly by the Navy and the Fish Commission. The *Albatross* cruised mainly in the Bahamas area to collect hydrographic data. Baird also directed the ship's crew to determine if the Bahamas were the winter home for the pelagic fish species that appeared each spring off the Mid Atlantic coast, but no evidence to support that theory was found. However, useful data were collected for the Commission on the sponge fisheries off Nassau. Productive hauls of biological specimens also were taken from the Straits of Florida and in the Gulf Stream south of Cape Hatteras (Tanner, 1888:605–606; USFC, 1892:x–xi).

In the summer of 1886, the ship returned to New England. After a cruise to the Gulf Stream Slope in July, Baird assigned the *Albatross* to investigate possible uncharted shoals near the cod and halibut banks off Nova Scotia and Newfoundland. Those banks were not confirmed. In September and October 1886, the *Albatross* deployed from Woods Hole to once again explore the deep waters stretching seaward of the Continental Shelf. Research stations were established in waters as deep as 1,867 fathoms where Zera Tanner reported that a "vast amount of material" was collected. The ship returned to the Wash-

[15] *Albatross* Deck Log, Oct. 1885, Record Group 24, U.S. Natl. Archiv.

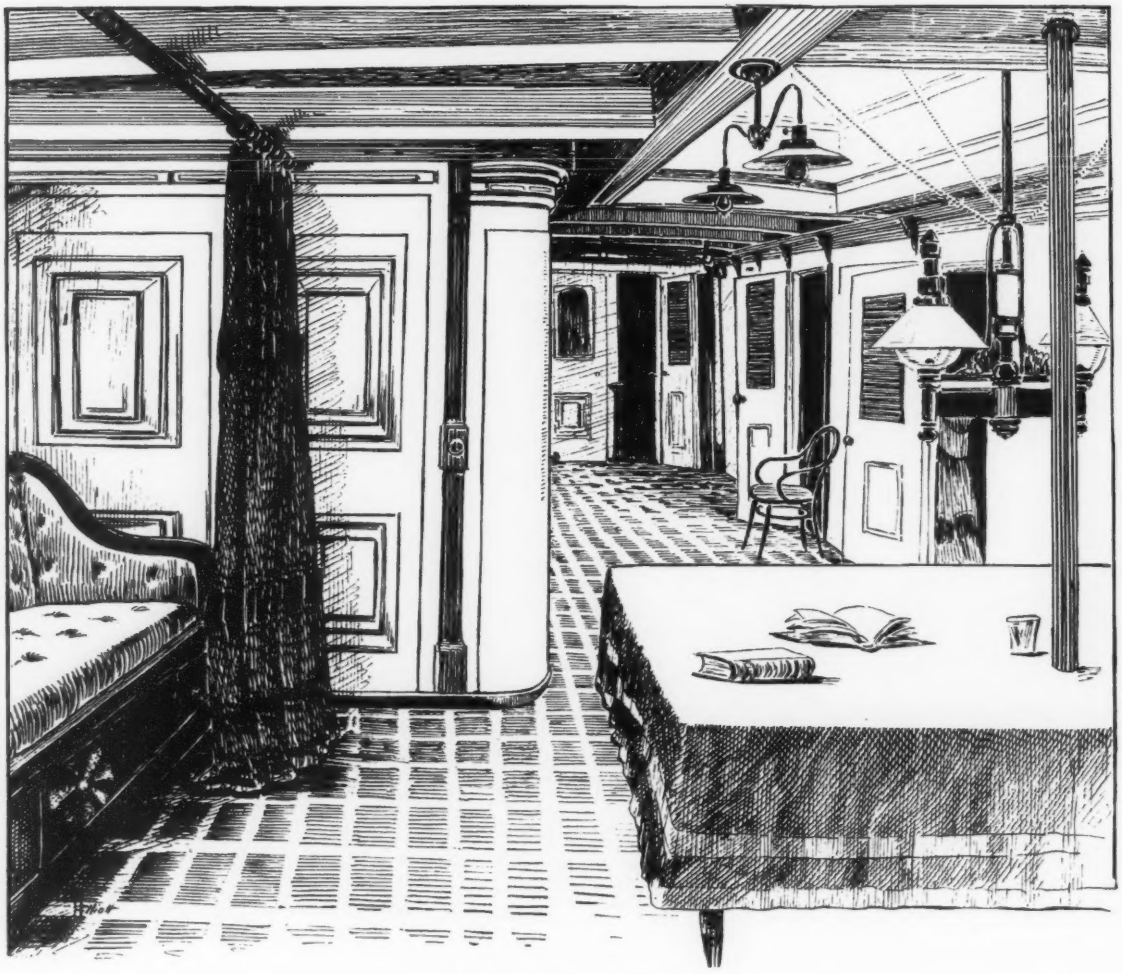


Figure 17.—The ward room.

ington Navy Yard in late October (Tanner, 1888:622–623, 668; USFC, 1892: xi–xii).

Another event in 1886 had a major impact on the future of the *Albatross*. In obtaining Congressional approval for the *Albatross* 5 years earlier, Spencer Baird specified that his ship could be useful in expanding American fisheries in the Pacific, as well as in the Atlantic and Gulf of Mexico. Following up on this suggestion, the Commissioner requested funds for the ship's transfer to the U.S. west coast, especially to study the area from "California northward to Alaska," where Baird noted that the fisheries were almost "totally undeveloped." Congress approved this proposal in August 1886. At the same time, Congressional funds were provided for the replacement of the defective boilers that had plagued Commander Tanner and his crew since 1883 (U.S. Congress, 1887:2, 23).

The *Albatross* remained in a prolonged repair status throughout the first 9 months of 1887 in preparation for her cruise to the Pacific. The ship was at the Washington Navy Yard until May when she shifted to the Columbian Iron Works in Baltimore for the boiler work. The ship's naval engineer, George W. Baird, personally designed the replacement boilers and supervised their installation.

The challenges so often involved in ship maintenance are revealed in Engineer Baird's official report. He was deeply frustrated when the Columbian Iron Works took twice as long as originally estimated to complete its job. The engineer's anxiety was heightened by the tense labor relations at the shipyard. The unionized Columbian Iron Works workers, resentful that naval crew members undertook some of the work associated with the installation of the new boilers, constantly threatened to strike. Nevertheless, a work stoppage

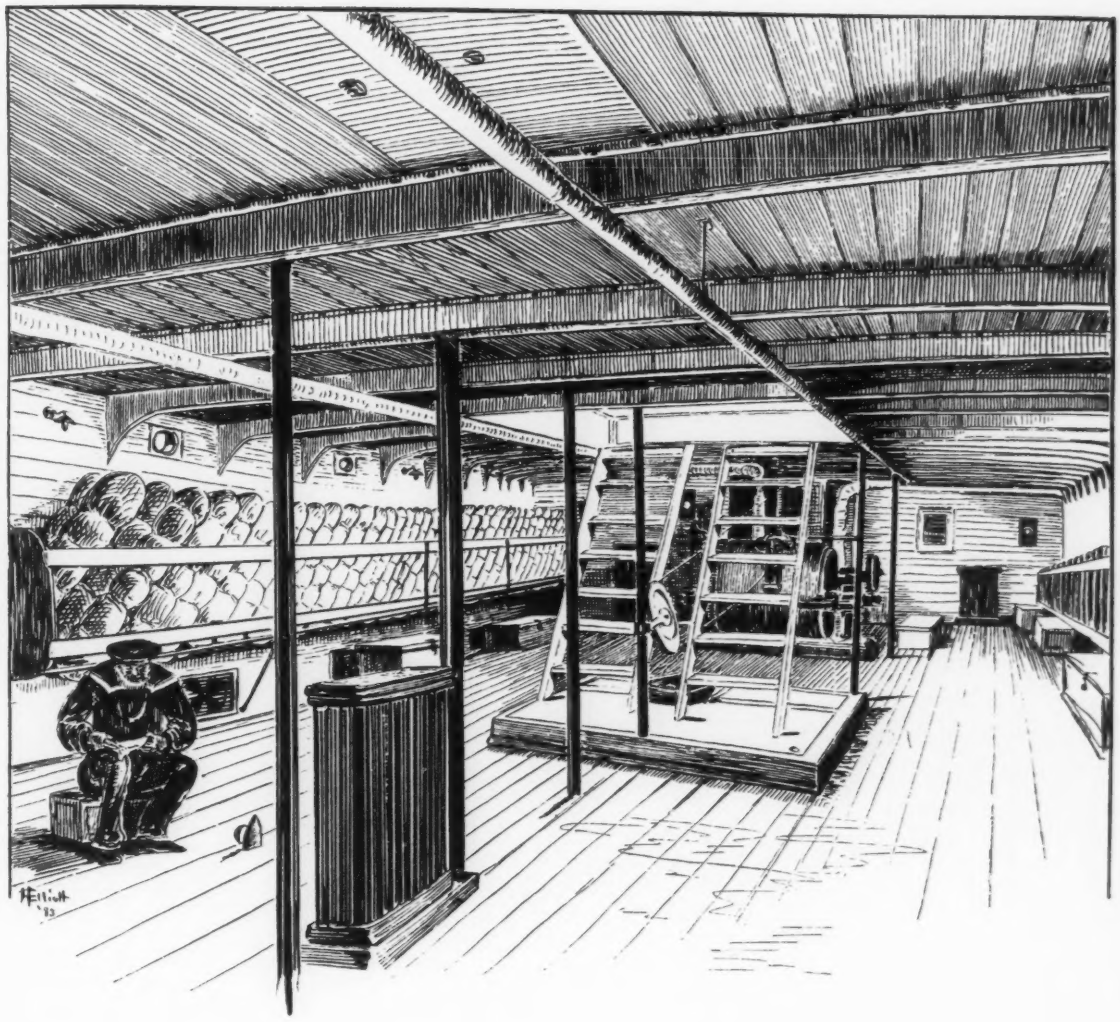


Figure 18.—The berth deck, looking from forward aft.

was avoided, and to Engineer Baird's intense relief, in September 1887 the boilers were finally in place and tested[16].

One month earlier, Spencer Baird had died in Woods Hole, and in November 1887, the *Albatross* took her own departure from the Atlantic. In a 7-month, 16,000-mile voyage, she sailed from Norfolk, Va., cruised down the South American east coast, transited the Straits of Magellan, shaped a northerly course for the Galapagos Islands, and finally reached her destination in San Francisco, Calif., on 11 May 1888.

It is fitting that, during her long transoceanic voyage, this pioneering research vessel carried a scientific party led by Leslie A. Lee, who, with his associates, established more that 125 dredging and hydrographic stations (Hedgpeth, 1945:18). This work was a preamble to the distinguished scientific contributions made by the ship in the Pacific Ocean for the next 30 years.

After being taken over by the Navy during the Spanish American War and again in World War I, the *Albatross* once again served as a research vessel in the Caribbean and Atlantic until finally decommissioned in 1921; Mooney (1991:135–138) provides an overall history of the *Albatross*.

[16] Engineer Baird's account is in Tanner (1890:418–435); see also USFC (1889:lii–liv).

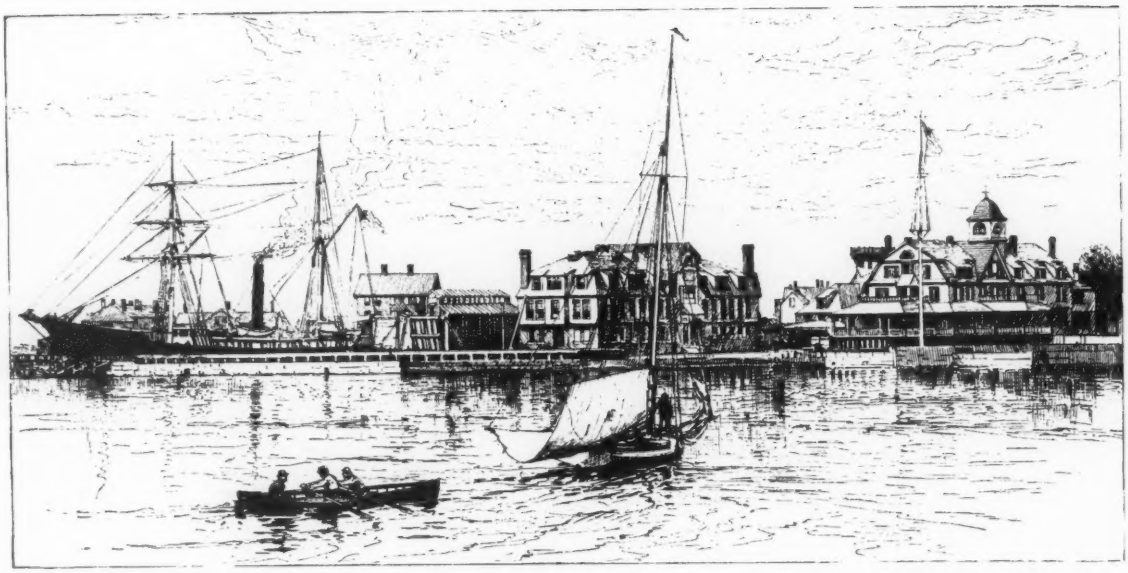


Figure 19.—The Woods Hole station of the U.S. Fish Commission, ca. 1886. At left is the *Albatross*, center is the laboratory building, and the residence is on the right.

Three general points may be made in taking stock of the early years of the *Albatross*'s history. First, the story underscores Spencer Baird's importance as a builder of institutions that promoted the study of science in 19th century America. In forming the U.S. Fish Commission, Baird recognized that research in the earth's little-explored oceans had great scientific value (USFC, 1873). He also knew that this type of activity required more than interested individual researchers; it also demanded the resources that only a relatively large organization could provide.

In modern terms, one could say that a "big science" approach was essential. The Commissioner's pronounced political skills made it possible for him to obtain the authority and funds, as well as the involvement of the U.S. Navy and other government agencies, that allowed the Fish Commission to become one of the world's leading research institutions in the ocean sciences. His ability to build the *Albatross*, widely recognized as the world's first large purpose- built research vessel, was of particular importance as marine scientists shifted their attention to deep oceanic waters (Allard, 1978:348–350, 353–355).

Secondly, the *Albatross*'s early history reflects the scientific distinction of the Baird program. There is little doubt that he viewed the Fish Commission's basic scientific survey of the Northwest Atlantic as having primary importance (U.S. Congress, 1891:66–67; Rathbun, 1892:680). It is equally clear that his simultaneous investigation of the biology, physics, and chemistry of the seas revealed a sophisticated approach to ocean science. In fact, the validity of his agenda continues to be recognized by modern scientists. For example, John Hobbie, the current Co-Director of the Marine Biological Laboratory's Ecosystems Center in Woods Hole, has stated that Baird was one of the pioneers in ecology who created "new approaches to questions of interactions of organisms and their physical, chemical, and biological environment." Hobbie concluded that Baird set modern fisheries research "off in an holistic, ecological direction" (Galtsoff, 1962:11; Allard, 1990:269).

Baird's pursuit of applied projects in support of American fisheries, such as his search for new fishing grounds, also revealed the Fish Commissioner's willingness to intermix practical programs with abstract science. This approach reminds one of David Starr Jordan's observation that Spencer Baird had a "theory of utility in science" in which "knowledge loses nothing through acquiring human values, and research takes on a certain dignity by serving at once intellectual demands and human necessities" (Jordan, 1922:I, p. 287).

Thirdly, the activities of the *Albatross* are an essential component of the pioneering survey of the northwest Atlantic that was undertaken by the U.S. Fish Commission between 1871 and 1887 (Allard, 1997). The relative intensity and sustained nature of this work are worth particular notice since, as Robert Cowen (1960:46) once observed, most oceanographic work in the 19th Century was based on "scattered soundings, samplings, and dredgings" that revealed only the "gross characteristics" of maritime areas. The validity of Cowen's observation is revealed in Table 1 which shows the limited number of research stations established by other expeditions of this period, including

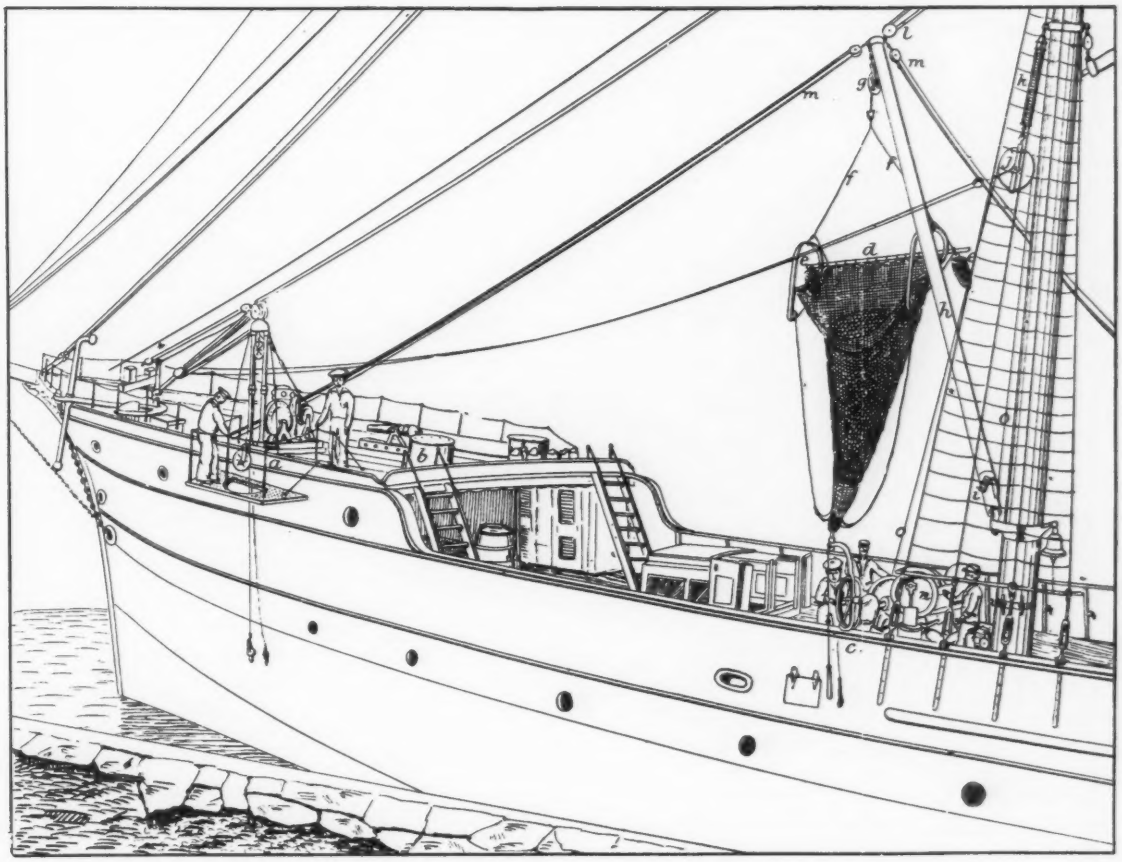


Figure 20.—The bow of the *Albatross*, showing the location of the dredging boom and sounding machine.

the relatively small number of Atlantic stations logged by the HMS *Challenger* during her circumnavigation of the world during 1872–76.

Yet, in comparison to the activity of the *Challenger*, as well as to the cruises made by Louis and Alexander Agassiz in U.S. Coast Survey ships and various contemporary expeditions in European waters, Table 1 demonstrates that the U.S. Fish Commission undertook a sustained program over a period of 17 years featuring more than 2,000 dredging stations concentrated in the northwest Atlantic.

During the 1870's, those investigations focused on the coastal shelf of New England. When the *Fish Hawk* became available in 1880, that ship investigated mid-water depths especial-

Table 1.—Dredging stations, 1871–87 (Source: Smith, 1889).

	Number of stations	
Agency, vessel, and cruise	North of Cape Hatteras	South of Cape Hatteras
U.S. Fish Commission, 1871–87		
Various ships assigned, 1871–79	1,075	
Fish Hawk, 1880–82	385	
Fish Hawk, 1883-87	96	
Albatross, 1883-87	518	230
Total	2,074	230
Agassiz-associated U.S. Coast Survey Ships, 1867–72, 1877–80		
L.F. Pourtales cruises, 1867–72		258
A. Agassiz in *Blake*, 1877–80	48	288
Total	48	546
Other Operations, 1867–83		
Lightning and *Porcupine*, 1867–70	194 stations north of the U.K.	
Challenger, 1872–76	About 180 in N. and S. Atlantic	
Swedish Arctic Expeditions, 1875-79	190 in Arctic Waters	
Le Travailleur, 1880–83	198 in Eastern Atlantic and Mediterranean	
Talisman, 1883	156 in Eastern Atlantic	

ly along the Gulf Stream Slope. The role of the *Albatross* after 1883 was to extend the Commission's survey into Atlantic abyssal waters in depths that approached 3,000 fathoms.

It should not be forgotten that the *Albatross*'s 748 biological dredging stations were in addition to the 1,088 hydrographic stations established by the ship between 1883 and the fall of 1887. Unlike her biological work, however, the ship's hydrographic activity was concentrated in waters south of Cape Hatteras (Smith, 1889; Hedgpeth, 1945:16–17).

The U.S. Fish Commission statistics in Table 1 support the validity of an 1891 assertion by the Johns Hopkins University biologist William Keith Brooks[17]. That scientist—a former student of Alexander Agassiz, a designated specialist for some of HMS *Challenger*'s collections, and the mentor of several prominent members of a new generation of American biologists—claimed that the Fish Commission's survey represented the first governmental effort anywhere in the world "to undertake the exhaustive scientific exploration of the ocean." Further, Brooks asserted, the Commission's "lead has been followed by most of the maritime nations of Europe." He added that "most of the machinery and apparatus which these foreign countries have employed has been modeled after that which has been devised and used by our Fish Commission" (U.S. Congress, 1891:544–545).

In summary, the *Albatross*'s work was the deep-sea component of the Fish Commission's historic survey of the northwest Atlantic between 1871 and 1887 that so impressed Professor Brooks. The ship's early years in the Atlantic demonstrated the major importance of the *Albatross* and should remind us of the U.S. Fish Commission's overall contributions to the annals of marine science during the era when it was directed by Spencer Fullerton Baird.

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Cruises of the *Albatross* off San Diego and Other Parts of Southern California, 1889–1916

JOHN R. MORING

Introduction

When the U.S. Fish Commission steamer *Albatross* was reassigned to the Pacific coast in 1888, a key mission was to study the aquatic life and hydrology of Pacific waters. Although it may be overly simplified to state that little was known of the scientific aspect of these aquatic resources, this was an accurate assessment. The Pacific coast had been explored for centuries, but not necessarily with fisheries science as a focus. The Spanish had the longest record of coastal exploration, but ship crews typically did not include artists, illustrators, or scientists until the eighteenth century. Even then, the term "scientific investigation" typically referred to depth soundings or botanical observations (Cutter, 1963). There were some observations of terrestrial animals and observations of the customs of Native Americans, but essentially these voyages concentrated on nonaquatic observations.

When early investigators noted aquatic animals, it was usually related to commercial value (Kelsey, 1984). British ships often carried along naturalists, but American vessels were largely concerned only with commercial products, such as sea otters, *Enhydra lutris*; northern fur seals, *Callorhinus ursinus*; and Pacific salmon, *Oncorhynchus* spp. Residents of California had localized knowledge of some fish species and certain invertebrates (e.g. abalone, *Haliotis* sp.; spiny lobster, *Panulirus interruptus*) but, when the *Albatross* arrived in 1888, a large gap remained in knowledge about aquatic resources of the Pacific coast. The contributions of the *Albatross* and its crew are particularly renown for investigations of fur seal and Pacific salmon fisheries in Alaska and the discoveries from several long trans-Pacific voyages. But investigations in waters of southern California, particularly near San Diego, also had significant impacts on scientific knowledge.

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ABSTRACT—Between 1889 and 1916, the U. S. Fish Commission steamer Albatross *made numerous trips to waters off southern California, particularly in and near San Diego Bay. The typical pattern for many years was to conduct cruises in waters off the Pacific Northwest or Alaska in summer months and waters off southern California in winter months. The* Albatross *conducted the first depth soundings and benthic profiles for southern California waters and secured the first samples of many endemic marine animals of this region.* Albatross *collections formed the basis for numerous definitive monographs of invertebrates and vertebrates that were published in subsequent years. The* Albatross *anchored in San Diego Bay in 1894, conducting the first biological investigations of the bay, and returned to sample again in many subsequent years. The ship and its crew also examined Cortez and Tanner banks for exploitation potential and conducted the first biological investigations of southern California's tuna stocks in 1915 and 1916.*

Early Investigations

The *Albatross* arrived in California in the spring of 1888 after a long voyage around Cape Horn. Stopping in San Diego Bay on the way northward, the crew went aboard a Chinese fishing junk that was anchored there (Fig. 1), but otherwise did no scientific studies, other than the typical soundings, weather, and temperature recordings that had been part of the sailing routine. This stop in San Diego Bay was brief; the ship sailed to San Clemente Island (Fig. 2), then northward to San Francisco, arriving in May 1888. But the *Albatross* would return to San Diego and other parts of southern California on numerous occasions over the next quarter century. In over one-third of the years that the *Albatross* cruised the Pacific, it conducted scientific investigations in and around San Diego Bay. The typical pattern for many years was to visit Alaska or the Pacific Northwest in summer months and southern California or Baja California in winter months.

Those investigations began in January 1889 when the *Albatross* traveled to the Santa Barbara Channel (Fig. 3). Sablefish, *Anoplopoma fimbria,* and several species of rockfish, *Sebastes* spp., were collected with trawls (longlines), and naturalists also went ashore on some of the Channel Islands. On Santa Rosa Island, they collected birds and an endemic fox, (the Santa Rosa gray fox, a subspecies of the gray fox, *Urocyon cinereorgenteus*), as well as some human skulls and skeletons—one of them in almost perfect condition (Tanner, 1892). Charles Gilbert reported "a great number of ancient human remains exposed on a strip of drifting sand 200 yards in width, extending from Carrington Point to the sea, a distance of about three-quarters of a mile," with numerous broken stone mortars (Tanner, 1892). Of particular note, however, was the almost total absence of life in the surface waters of a transect extending between one of the islands and the mainland. This was un-

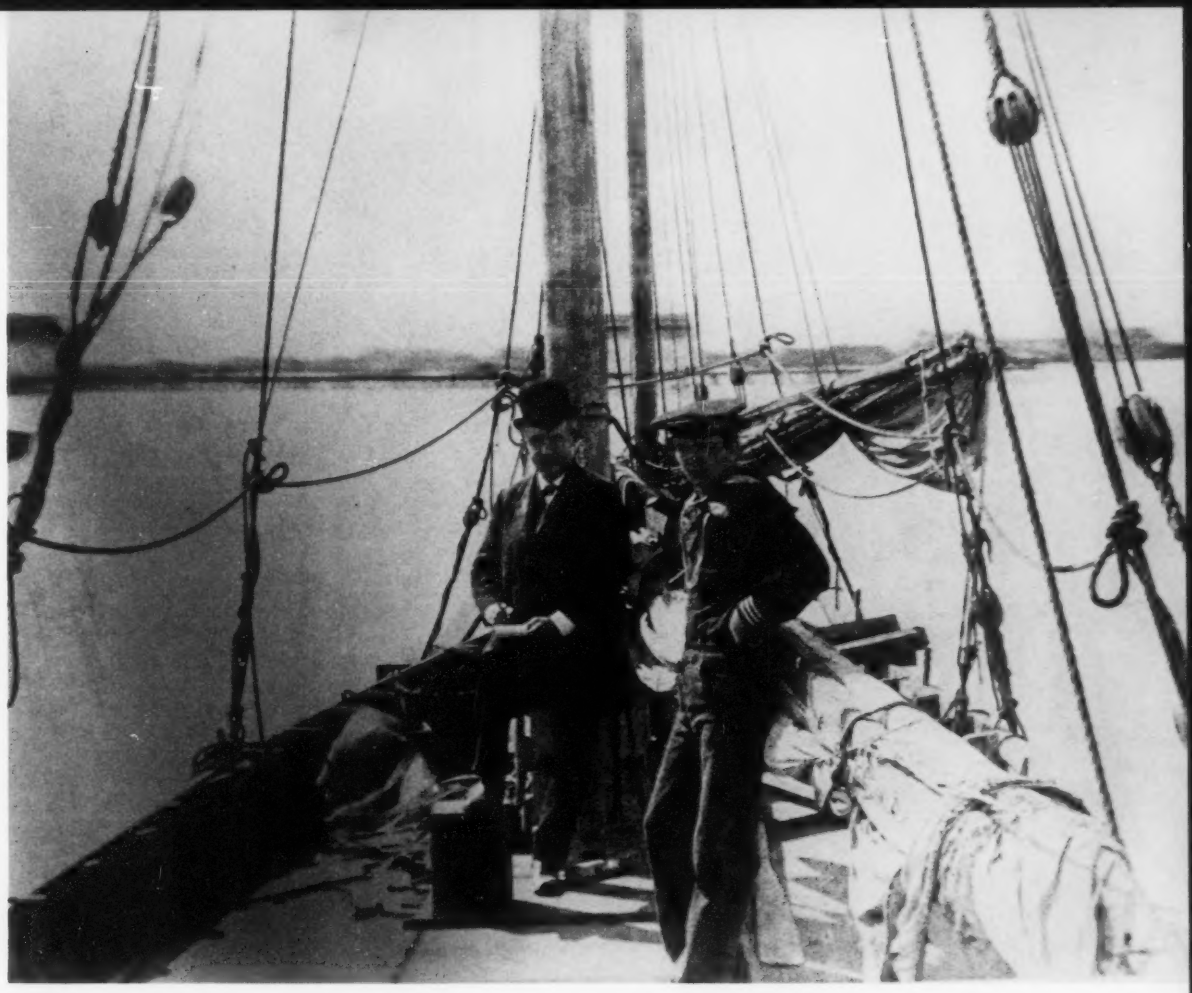

Figure 1. —Members of the *Albatross* crew aboard a Chinese fishing junk anchored in San Diego Bay, spring, 1888. Photograph courtesy of the National Archives, College Park, Maryland.

explained by season or other factors, but the scientists concluded that the condition was likely a consequence of natural oil seepage (Tanner, 1892): "The presence of petroleum, which may be seen forming a thin film over the surface waters of the channel, may have something to do with it."

A. B. Alexander, the Fishery Expert on board, also noted "extensive 'slicks'" on the surface, caused by petroleum bubbling up through the water. "Oil is frequently reported by the fishermen and sea captains in this vicinity, sometimes in small patches and at others covering large areas." (Alexander, 1892). Alexander theorized that the presence of oil also may have affected the presence and movements of migratory fishes.

The scientists investigated the potential for oyster culture in Alamitos Bay and Newport Harbor, recording physiochemical conditions, then extended a transect west from Pt. Loma (the western border of San Diego Bay) and explored Cortez Bank—known to local residents but largely unexplored or exploited (Fig. 4). The *Albatross* produced the first accurate maps of the Bank, helped in large part by the presence of Bishop's Rock. The Rock was only 3–4 m deep, with waves often breaking overhead, so the ship could accurately orient and map the area around it. A number of fish species were captured, including two giant sea bass, *Stereolepsis gigas,* that weighed 70 and 86 kg (Alexander, 1892).

The investigators concluded that Cortez Bank's rich fauna was a promising offshore fishing ground on the California coast south of San Francisco (Tanner, 1892). It had heretofore remained unexploited because of the low demand for fish and the lack of appropriate fishing gear. At the time, fish brought only 3–4.5 cents per pound. Thus, the added expense of traveling to an offshore bank, however rich, was not justified economically. Add to this, California commercial fishermen did not have the more sophisticated gear used by those on the U.S. east coast, and certain types of gear were not cost effective to buy. As a consequence, although the *Albatross* scientists could recommend exploiting fishes at off-

Figure 2.—San Clemente Island, photographed by members of the *Albatross* crew on the ship's maiden voyage to the Pacific Coast, 1888. Photograph courtesy of the National Archives.

shore banks, there was little profit in doing so (Alexander, 1892).

During this same voyage in 1889, the *Albatross* mapped another unexplored bank—Tanner Bank—and visited several offshore islands, including San Clemente and San Nicholas. Scientists obtained information on fisheries and fish species from interviews of local residents. Although the scientists sometimes worked in near-gale conditions, they did encounter more human remains and stone implements on San Nicholas Island but rather barren biota. They noted a small, but active cottage industry for abalone shells (San Nicholas Island) that were shipped up and down the coast by Chinese harvesters (Alexander, 1892). There also were local fisheries for spiny lobsters that were collected with pots around offshore islands, then held until collected by a larger sloop that visited at regular intervals. Other local fisheries were exploiting "fat-heads" (California sheephead, *Semicossyphus pulcher*), "whitefish" (ocean whitefish, *Caulolatilus princeps*), and "red rock-cod" (likely the yelloweye rockfish, *Sebastes ruberrimus*, formerly known as the red snapper). The cruise concluded with measurements and biological samples along several transects off southern California, as far south as the Coronados Islands, and special studies of the biology of and fisheries for mackerel (chub mackerel, *Scomber japonicus*, formerly known as Pacific mackerel), Pacific bonito, *Sarda chiliensis*, and Pacific barracuda, *Sphyraena argentea*. On its way northward, the *Albatross* sampled along transects from Pt. Loma to Pt. Fermin, then between several offshore islands and the Santa Barbara Channel. Several commercially important species, such as "deep-water sole" (likely several species but definitely including rex sole, *Errex zachirus*), and the locally-known California halibut, *Paralichthys californicus*, were collected from previously unknown as well as exploited banks (Tanner, 1892).

Although the *Albatross* had stopped in San Diego Bay on several occasions to take on coal, it was not until 1894 that the ship conducted the first detailed scientific investigations of the bay and

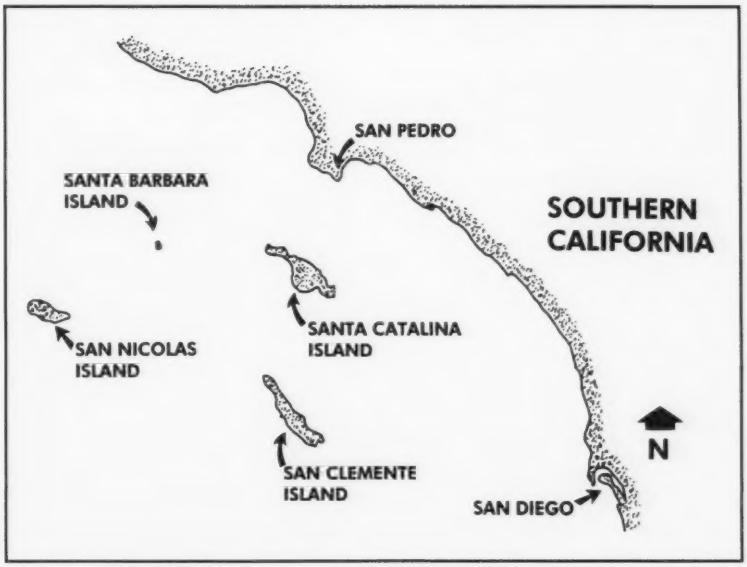

Figure 3.—The coast of southern California, including offshore islands.

its resources. The ship anchored in the bay for three months after "a boisterous trip." from the north in early January (Tanner, 1896).

One interesting observation was made en route. In February and March 1894, there were several reports in newspapers of coastal communities about extensive numbers of dead fish (Drake and Tanner, 1896). Although the *Albatross* itself did not investigate these mass mortalities, a member of the scientific staff, Assistant Fishery Expert N. B. Miller, traveled on a local steamer, the *Santa Rosa,* and, after interviewing local skippers, reported a string of dead fish from Santa Barbara southward to almost San Diego (there were no dead fish off Pt. Loma (San Diego) or False Bay (now known as Mission Bay). Extensive numbers of dead barracuda, flatfish, yellowtail, *Seriola lalandi*; Pacific sardines, *Sardinops sagax*; sea bass, Serranidae; northern anchovy, *Engraulis mordax;* and rockfish, *Sebastes* spp. were noted. In one half-mile stretch alone, near Redondo Beach, Miller counted 168 flatfish and 225 barracuda floating on the surface. He examined some of the dead fish washed ashore near Redondo Beach and found empty stomachs and ruptured air bladders. The gill rakers were covered with a yellow slime that emitted the telltale smell of petroleum. Despite these seemingly adverse influences on marketability, the dead fish were being actively gathered and sold to markets in Los Angeles. Others were served at local hotels and aboard coastal steamers (Drake and Tanner, 1896). Miller theorized that some type of seismic disturbance had released oil from the bottom, thus triggering the massive kill.

In 1896, the *Albatross* was back in southern California, spending the first 4 months of the year examining fishes and invertebrates. The ship's crew concentrated on the area near La Jolla, Pt. Loma, and San Diego Bay (Fig. 5), using the ship's five launches to conduct studies in San Diego Bay from 30 January to 12 April (Fig. 6). The *Albatross* itself served as a stationary laboratory (Fig. 7). A particular objective was to examine the bay as a candidate for oyster culture (Brice, 1898). Water temperatures in the bay during winter ranged from 11° to 19°C.

After completing the studies in San Diego Bay, the *Albatross* cruised southwest to the Coronado Islands, then north in April 1896 to Cortez and Tanner Banks, and on to Santa Catalina Island. Stormy weather restricted the investigations to just soundings and one trawl haul, but the ship's scientists concluded that the depth profiles at the two banks "promise considerable inducement for a local fishery whenever a demand shall have been established" (Brice, 1898). In Santa Barbara, the ship participated in the annual Flower Festival of Santa Barbara in mid April, then went south to become a star attraction in San Pedro's Fiesta de Los Angeles during 20–26 August 1896. Wherever the ship traveled, the crew kept steaming records of whales, kelp, and aquatic birds, as well as water temperatures, weather conditions, depth readings, and records of bottom characteristics. Some records, such as reports of "many puffins," while traveling between San Diego and Santa Barbara (Anonymous, 1898), are useful in considering distribution of such birds a century later.

Investigations in 1897 concentrated on Santa Catalina Island and the Santa Barbara Channel. The ship explored the shelf around Santa Catalina Island, using gillnets, dredges, handlines, seines, longlines, and beam trawls. The aquatic environment was investigated in detail from the intertidal zone down to a depth of about 80 m. Fishes collected were primarily smelt, Osmeridae; herring, *Clupea harengus*; and anchovies, but scientists also captured Pacific barracuda, Pacific bonito, albacore, *Thunnus alalunga*; yellowtail, and rockfish. There were few local fisheries around Santa Catalina Island, except for spiny lobsters and seasonal fisheries for sardines. An indication of how extensive these fish collections were is reflected in an annotated checklist prepared by Charles Gilbert: 63 species of fishes were captured around Santa Catalina Island and Monterey Bay in April 1897 alone (Gilbert, 1899). Many of these fishes were species of rockfish, but there were several species new to science and many others unknown to local commercial fishermen.

The ship returned to San Diego Bay in January 1898, then again visited Santa Catalina Island for a week in April. At the latter locale, the scientists

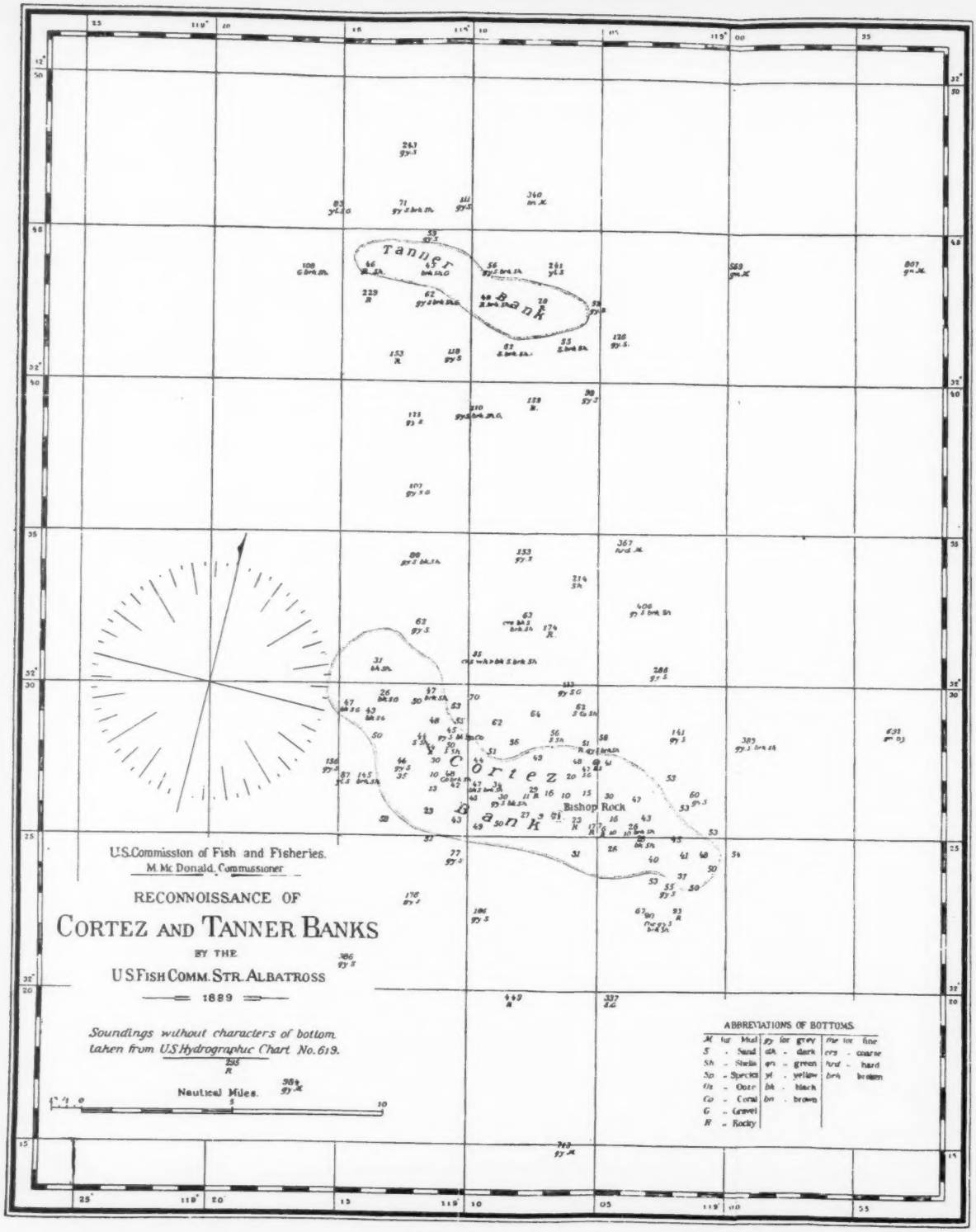

Figure 4. — The first published map of Cortez and Tanner banks (Tanner, 1892), using soundings by the *Albatross* in 1889.

again collected along the shelf, adding to the increasing knowledge of aquatic life and bottom topography near that large island. Moser (1899) reported that migratory species had yet to make their appearance at that time of year, but extensive sampling with seines, gill nets, trawls (long-lines), beam trawls, and hand lines at depths between a "few" meters and 238 m collected smelt (Osmeridae) and rockfish up to 3.6 kg in size. In addition, a few yellowtail also were taken, and the scientists compared the swimming behavior of yellowtail to that of pollock (*Pollachius virens*) of the Atlantic coast. The scientists encountered what local anglers and subsequent scientists would document in more detail—that species of rockfish were quite locale-restricted (Moser, 1899).

Later Investigations

Following its transfer to the U.S. Navy during the Spanish American War, the *Albatross* revisited San Diego Bay in 1903, along with Cortez Bank and Santa Catalina Island, as well as Monterey Bay as part of a cooperative cruise between the U.S. Fish Commission, Stanford University, and the University of California. Again, transects, benthic dredging, and surface and midwater sampling were underway almost continuously during the cruise, with a primary objective being exploration of new fishing banks. Many, small offshore banks were logged in the steaming records and mapped.

One of those new offshore banks was discovered and mapped during a cruise in 1904. In March and April, the *Albatross* sampled in the waters off Pt. Loma, La Jolla, the Coronado Islands, and Santa Barbara. A transect was extended 322 km westward from San Diego, out to the 3,660 m curve, and the crew mapped previously known banks or areas only locally known (Bowers, 1905b). One of those rocky shoals discovered was Cabral Bank, named after a local fisherman who served as a guide (Bowers, 1905a).

Tuna Investigations

The last major scientific effort by the *Albatross* in southern California waters was directed at tuna, Scombridae, populations. Beginning in 1907, when the operator of a local San Pedro sardine cannery, A. P. Halfhill, started experimental canning of albacore (Roedel, 1938), the southern California industry had grown steadily. Trial-and-error resulted in an effective technique for canning tuna in vegetable oil. Between 1909 and 1913, the pack of tuna rose from just 250 cases to 115,000 cases and the number of canneries rose to nine in San Pedro and San Diego (Smith, 1915). In 1916, 10.5 million kg of albacore were taken (Clemens and Craig, 1965). But there were concerns about the population numbers and the long-term prospects for expanding the fishery.

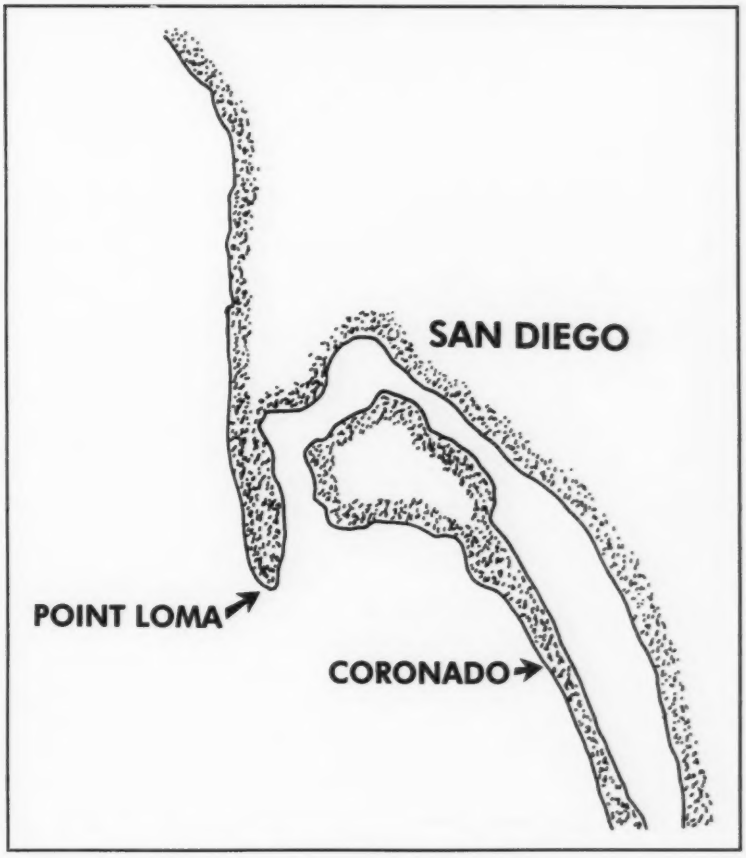

Figure 5.—San Diego Bay and surrounding waters.

In 1914, the typical fishing method was hand lines and chumming with sardines and other small baitfishes. Rather than the later tuna clippers and purse seiners, tuna were taken by small boats powered by 8 hp motors and manned by crews of two to four. These boats did not venture far offshore, but the consensus was that catches of tuna could be considerably higher if the men had larger boats that could travel farther offshore and make longer trips (Smith, 1915). Three species of scombrids were captured in the fishery, but most effort was with albacore. However, there was little knowledge of the biology of albacore or why the species seemed so seasonal—even erratic—in its appearance along the southern California coast. For example, commercial harvesters noted that albacore were present in southern California waters in early spring, but the fish often disappeared from these

Figure 6.—One of the launches from the *Albatross* loading sampling equipment from the larger vessel, 1888. Photograph courtesy of the National Archives.

waters close inshore between June and November (Smith, 1915). Before the industry could consider expanding, these life history questions needed to be resolved.

It was the *Albatross* that conducted the first studies on tuna populations. In 1915, using very limited funds, the scientists tagged and released some tuna. But the effort was minimal, and reports could only conclude that "unfortunately, the tuna can not be counted upon to appear in abundance with any regularity" (Smith, 1917). When politicians were urged to address the issue further, Congress appropriated $16,000 in 1916 to fund further investigations of tuna populations by the *Albatross*.

During April and May, 1916, the ship spent 3 weeks cruising along Baja California, traveling several hundred miles south and west to the Coronado Islands. The ship anchored in San Diego Bay for a brief period in mid May, then undertook a second cruise along Baja California. Despite taking two of "the best practical tuna fishermen of San Diego" along on this voyage, no tuna were encountered (Smith, 1917). In late May 1916, tuna started to appear off San Geronimo Island and the San Benito Islands, Mexico, but none were encountered for 240 km west of San Diego. In June, the *Albatross* started to encounter tuna off San Diego and San Pedro, but not in large numbers—certainly far from economically attractive levels—and possibly a reflection of relatively cool water temperatures.

Figure 7.—The upper laboratory aboard the *Albatross*. Photograph courtesy of the National Archives.

Thompson (1917) concluded that the presence or absence of albacore was largely due to water temperatures—the first definitive evidence linking albacore and specific oceanic isotherms, based in large part on these tuna investigations by the *Albatross*. Later researchers improved knowledge of this relationship (e.g. Johnson, 1962) and developed predictive models of albacore distribution and abundance (Hester, 1961; Clemens, 1962; Rothschild and Yong, 1970).

The *Albatross* continued to study tuna until 23 November 1916, when the ship was ordered back to San Francisco. It was later put under U.S. Navy control for World War I and those scombrid investigations in 1915 and 1916 effectively marked the end of the *Albatross*'s scientific investigations along the southern California coast.

Summary

An examination of the role of the *Albatross* in aquatic investigations in and around San Diego and along the southern California coast reveals extensive hydrological records and numerous volumes of scientific discoveries that were still being published decades after their initial collection (e.g. Gilbert, 1891, 1896, 1915). It also should be noted that many of these contributions to science were not solely aquatic. Terrestrial animals were collected from many of the offshore islands, including lizards, and a new genus and species of insect that was collected on San Clemente Island in 1888 (Howard et al., 1890). The *Albatross* conducted the first scientific investigations of San Diego Bay and discovered and mapped several important offshore fishing banks. Finally, some of the earliest work on albacore along southern California—including the first tagging—was conducted by the *Albatross*, its scientists, and its crew.

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The Great *Albatross* Philippine Expedition and Its Fishes

DAVID G. SMITH and JEFFREY T. WILLIAMS

ABSTRACT—The Philippine Expedition of 1907–10 was the longest and most extensive assignment of the Albatross*'s 39-year career. It came about because the United States had acquired the Philippines following the Spanish-American War of 1898 and the bloody Philippine Insurrection of 1899–1902. The purpose of the expedition was to survey and assess the aquatic resources of the Philippine Islands. Dr. Hugh M. Smith, then Deputy Commissioner of the U.S. Bureau of Fisheries, was the Director of the Expedition. Other scientific participants were Frederick M. Chamberlain, Lewis Radcliffe, Paul Bartsch, Harry C. Fasset, Clarence Wells, Albert Burrows, Alvin Seale, and Roy Chapman Andrews. The expedition consisted of a series of cruises, each beginning and ending in Manila and exploring a different part of the island group. In addition to the Philippines proper, the ship also explored parts of the Dutch East Indies and areas around Hong Kong and Taiwan. The expedition returned great quantities of fish and invertebrate specimens as well as hydrographic and fisheries data; most of the material was eventually deposited in the Smithsonian Institution's National Museum of Natural History. The fishes were formally accessioned into the museum in 1922 and fell under the care of Barton A. Bean, Assistant Curator of Fishes, who then recruited Henry W. Fowler to work up the material. Fowler completed his studies of the entire collection, but only part of it was ever published, due in part to the economic constraints caused by the Depression. The material from the Philippine Expedition constituted the largest single accession of fishes ever received by the museum. These specimens are in good condition today and are still being used in scientific research.*

Genesis of the Expedition

The year 1997 marked the 90th anniversary of the *Albatross* Philippine Expedition, the longest and most extensive of the ship's career. In the history of American maritime exploration, it was second only to the Wilkes Expedition in terms of time spent and area covered. In terms of the material collected and the pages published, the Philippine Expedition is in a class by itself and stands as one of the greatest of all oceanographic expeditions. That it took place at all is due to powerful political forces that converged at the turn of the last century.

As the 19th century drew to a close, the United States and Spain were passing each other going in opposite directions. The Spanish empire was collapsing. What had once covered half the known world was reduced to three islands in the Caribbean and, on the opposite side of the earth, the Philippines. By 1896, rebellions were raging in the two biggest and most important colonies, Cuba and the Philippines. The United States, by contrast, was on the way up. Its defining event of the 19th century, the Civil War, was fading into memory. The industrial revolution was in full swing, the frontier was closing, and the nation's restless energy was beginning to turn outward.

There were two other players in this drama. Neither had a speaking role, but both were waiting just offstage and cast a menacing shadow. One was Germany and the other was Japan. Like the United States, they were ascending and ambitious. The impending collapse of imperial Spain threatened a power vacuum, and the unspoken question of the day was: who would move in when Spain was inevitably pushed aside?

Cuba was of more immediate concern to the United States. American sympathy was strongly on the side of the Cuban rebels. Each new report of Spanish atrocities raised the pitch of excitement. In January 1898, President William McKinley sent the battleship *Maine* to Havana. This act was a message intended as much for Germany as for Spain. The United States was not about to allow a stronger European power to replace Spain in the Western Hemisphere. Tensions were high, and on 15 February 1898, a catastrophic event set off the spark. At 9:40 p.m. on a tropical winter evening, the *Maine* was blown apart in a colossal explosion. For a few terrible moments, the peaceful harbor was turned into an inferno. Flames and smoke rose high into the air, and the blast broke windows, put out lights, and sent plaster crashing down from the ceilings of buildings all over town. Altogether, 268 American sailors were killed, and any chance for a peaceful solution to the crisis vanished (O'Toole, 1984:126). Events spun out of control, and all the dominoes began to fall.

War was declared by both Spain and the United States. In the Pacific, Commodore George Dewey was ordered to take his fleet to Manila and engage the Spanish. The battle resulted in a complete victory for the United States. In the aftermath, Spain was forced to sell the Philippines to the United States. But for the Americans, the worst was just beginning. The Filipino rebels had no intention of simply replacing one colonial master with another. They continued to resist, and in February 1899, the United States went to war in the Philippines. It has been called the most divisive overseas war in American history until Vietnam. It raged for nearly 3½ years and involved 70,000 American soldiers, 7,000 of whom were killed or

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Figure 1.—Hugh McCormick Smith, Director of the *Albatross* Philippine Expedition.

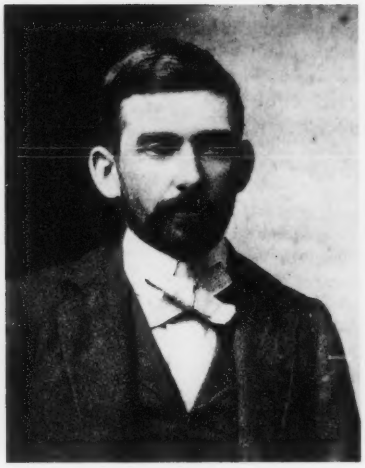

Figure 2.—Frederick Morton Chamberlain, Resident Naturalist of the *Albatross* during the Philippine Expedition.

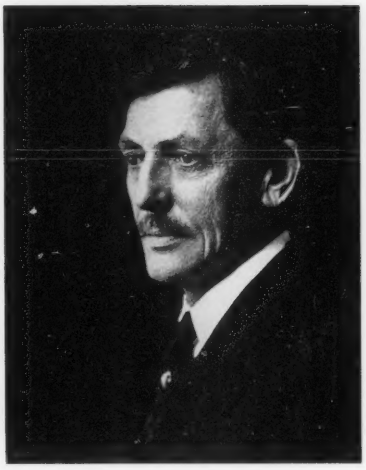

Figure 3.—Paul Bartsch, representative of the Smithsonian Institution on the Philippine Expedition.

wounded. Filipino casualties were even greater. An estimated 16,000–20,000 Filipino guerillas were killed. Civilian casualties, both direct and indirect, may never be known, but estimates range from 200,000 to as high as 500,000 (O'Toole, 1984:395). The war spawned a protest movement at home that would be unmatched until Vietnam. The Philippines did not come cheaply.

The Expedition

American power ultimately prevailed, and the war was declared over on 4 July 1902, although in fact resistance sputtered on for years afterward. By the middle of that decade, the situation had stabilized to a point where the United States could begin consolidating its power. One of the first orders of business was to survey the newly acquired territory and assess its resources, and the *Albatross* was given the job of surveying the aquatic resources of the islands. She had done similar service in the Hawaiian Islands when they were acquired, but the magnitude of the Philippine survey was far beyond any of her previous expeditions. The archipelago extends approximately 1,100 miles north to south, and almost 700 miles east to west. It comprises some 7,100 separate islands, ranging from mountainous minicontinents like Luzon and Mindanao to scraps of rock barely awash at high tide. The ecological diversity is equally great: rocky shores, coral reefs, mangroves, estuaries, deep ocean basins, and freshwater lakes and rivers. There was probably not another vessel in the world better suited for the work, and, in spite of her age (25 years), she was sent out on an expedition that would keep her away from home for 2 1/2 years.

The director of the expedition was Hugh McCormick Smith (Fig. 1), then deputy commissioner of the Bureau of Fisheries. To Smith fell the task of organizing the expedition: planning the itinerary, gathering the equipment, and selecting the civilian crew. His many administrative duties did not allow him to participate in the entire cruise, but he did arrange to be aboard for the first few months. Although the *Albatross* carried a crew of some 70 officers and enlisted men, the scientific crew was surprisingly small. Joining Smith on the initial leg of the expedition were Frederick M. Chamberlain (Fig. 2), the Resident Naturalist of the ship; Lewis Radcliffe of the Bureau of Fisheries, aboard as General Assistant and Naturalist; H. C. Fassett, Fishery Expert; Paul Bartsch (Fig. 3), a malacologist and the official representative of the Smithsonian Institution; and Clarence M. Wells, Assistant and Clerk.

On 16 October 1907, the ship left San Francisco on her way to Manila. It would be 2 1/2 years before she passed under the Golden Gate again. Bartsch recorded the scene in his journal:

> "There is scarcely any indication of a breeze this morning, and the swells are scarcely broken by a ripple. The sun is struggling bravely to disperse the fog which obscures the greater front of the shoreline of the bay. Numerous merchant ships and smaller craft crowd the warfs [sic] and the regular ferries between San Francisco, Sausalito, Oakland are plying back and forth. Two large government boats lie at anchor at a little distance from our vessel and our launch seems impatient to be off to shore for her last trip before we lift anchor and depart. Numerous . . . gulls are beating back and forth watching the vessels for discards from the cook's pantry. All is cheerful and if present indications augur well we should have a most successful and enjoyable expedition".[1]

[1] Paul Bartsch papers, Smithsonian Institution Archives, Record Unit 7089, housed in Division of Molluscs, National Museum of Natural History, Washington, D.C.

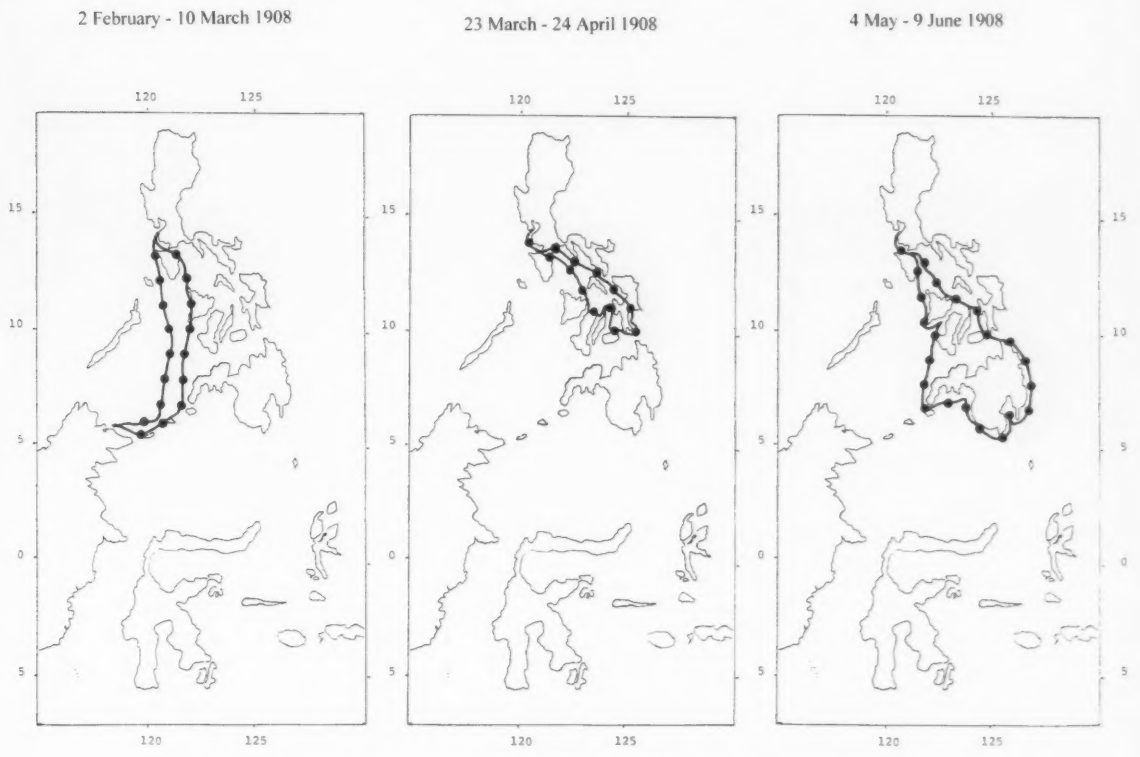

Figure 4.—First three cruises of the Philippine Expedition, from February to June 1908.

There are no entries in the journal for 19 and 20 October. On 21 October, Bartsch resumed his entries and explained the two-day gap: he was seasick! Smith, traveling separately, was already in Japan; he would join the vessel in Manila, along with the Japanese artist, Kumataro Ito.

The ship stopped at Hawaii, Midway, and Guam, making small collections along the way. On 28 November 1907 she steamed into Manila Bay, which would be her home base for the next two years. Smith arrived on 3 December, and the expedition proper could now begin—or at least it could have if all the equipment had been in place. Much of the major equipment had not yet arrived from the United States, and the ship was limited to short excursions in the immediate vicinity of Manila for the first month or so. The gear finally arrived, and on 1 February 1908 the first real cruise began.

The Philippine Expedition consisted of a series of individual cruises, each beginning and ending in Manila. The first cruise (Fig. 4), from 2 February to 10 March, went south from Manila around the eastern side of Mindoro, west of Panay, and through the Sulu Archipelago to Sandakan, British North Borneo (now Sabah, Malaysia). The second (Fig. 4), from 23 March to 24 April, explored the central islands, including Panay, Negros, Cebu, Leyte, Samar, Masbate, and Marinduque. The third (Fig. 4), from 4 May to 9 June, worked in the same direction but extended the coverage to the southern island of Mindanao.

The *Albatross* used a wide variety of collecting equipment. The most commonly and successfully used bottom trawl was a 12-foot Agassiz beam trawl. For deep work, a reversible net was used, which would fish regardless of which side it landed on. A mud bag was often attached to bring back quantities of bottom sediment along with the organisms it contained. A larger, 25-foot version was also available for use on smooth bottoms. Other bottom trawls included a 12-foot Tanner beam trawl, a 9-foot Albatross-Blake beam trawl, 6-foot and 9-foot Johnson oyster dredges, a 6-foot McCormick trawl, and a 2-foot Blake trawl, which was used in shallow water from a steam launch or a rowboat. Tows were made as deep as 2,275 fathoms (4,163 meters), although most were much shallower. Several varieties of pelagic nets were used. Ring nets came with mouth openings of 5.5 and 10 feet and with different combinations of lining and codends; some were rigged so that they could be closed at predetermined depths. Small plankton nets with various mesh sizes were used, often being towed concurrently with a bottom trawl. When the ship was at anchor, collections were often made with dip nets and night lights. Except for very shallow stations, depths were determined by a Tanner-Blish sounding device.

Parties were often sent away from the ship for shore collecting. Seines of various sizes were used, the most common being 130 and 150 feet in length. Reef fishes were normally collected with dynamite:

> "The method was to locate the desirable fishes in the coral growth by means of a view glass (a glass-bottomed box) used from a boat. A small charge of dynamite with electrical connections was carefully lowered and discharged. Such fishes as floated were at once collected with a dip net, and the place marked by a buoy. As soon as the bottom had cleared it was searched and the dead fish gathered by diving or more usually by means of long-handled spears" (Anonymous, 1910:5).

Other methods included gill nets, hand lines, and traps. In addition to all these methods, many specimens were purchased from local fishermen and in markets.

After each collection, the catch had to be prepared and preserved. This was before the days of formalin, and the fishes were preserved directly in ethyl alcohol. Large specimens had to be individually injected, and the alcohol would be changed several times. One can imagine the amount of fluid that had to be taken on board. The larger specimens were individually tagged with uniquely numbered metal or linen tags. The tag number was entered in a ledger along with information on the date and place collected, or the station number if it was from a trawl station, and a preliminary identification. A total of 24,389 linen tags and 6,231 metal tags were painstakingly attached to specimens, and virtually all of them are still firmly fixed to the specimens today. The brilliant colors of the fishes and invertebrates were as ephemeral then as they are now, but color photography had not been invented. Thus the artist had a vital role to play, and he prepared hundreds of color sketches of freshly caught specimens.[2] Mud bags accompanying the bottom trawls would be emptied into a hopper with screens of varying mesh size. This would then be washed with a hose, and as the organisms were revealed, they were removed for preservation. Of course, collection data were taken and recorded from each station. In addition to the date, time of day, position, and depth, information included bottom type, water temperatures and densities, length and direction of tows, and any noteworthy events that happened during the station.

Bartsch (1941) published a brief account of his experiences, taken from his journals, and provided a good impression of what it was like to be a participant in the expedition. When not actually in Manila or some other port, the ship was constantly on the move, rarely spending more than a day or two at any one place. "This," Bartsch reported, "gave us a wonderful contact with Philippine life in that day as we always came unannounced into the harbor serving for a night's anchorage." He added:

> "At daylight, after a cup of coffee and a bite in the galley, a boat would be put over-board and an effort made to enter some stream, if such were present, near our anchorage. On this trip collections would be made of fresh-water organisms when fresh water could be reached, as well as land animals, stressing birds, and among the plants, ferns. A vigorous blast of the siren if we failed to return to the ship by 8 a.m. would tell us that the ship was about to put to sea. The rest of the day up to about 5 o'clock would be spent in dredging operations, the number of dredge hauls varying with the depth of the water in which the work was being done, greater time being required for the deeper hauls" (Bartsch, 1941:212).

If time permitted after the ship anchored for the night, a boat might be sent out for more shore collecting. Night lighting was a favorite activity, which Bartsch reported "at times kept us so interested that we would fish the night through, gathering plankton hour by hour." On one occasion, Bartsch was so impressed by a living hatchetfish caught at the light that he awakened everyone on board, including the captain, so that they could see it. "The fact that I had not swung from the yard-arm next morning or been put in the brig, showed that the fish must have been interesting" (Bartsch, 1941). All the material collected would have to be processed, of course, a job that might continue far into the night.

On 9 June 1908 the *Albatross* returned to Manila to complete the third cruise of the expedition. Wear and tear had taken their toll on the ship, and it was determined that she needed extensive repairs, more than could be made in Manila. After some further trawling in the immediate vicinity of Manila Bay and southern Luzon, operations were suspended, and in August the *Albatross* was sent to Hong Kong for servicing. The material collected up to that point was packed and prepared for shipment back to Washington. Three of the scientists also departed around this time. Hugh Smith was the first to leave, in April, after the ship had returned from its second cruise. He was later followed by Radcliffe and Bartsch, who had stayed on for the third cruise. The loss of Bartsch is particularly unfortunate for us, since it meant the end of his meticulous journal entries.

It is uncertain who replaced these three men and what their term of service was. We can find no manifest listing the crew, and the published summary of the dredging and hydrographic records (Anonymous, 1910) does not list personnel at all. The ship's log sometimes recorded the arrival or departure of the scientists, but not in any complete or consistent way. Schmitt (1945: 24) mentioned three others: Alvin Seale, Albert L. Barrows, and Roy Chapman Andrews. Seale, a former student of David Starr Jordan at Stanford University, was working at the Philippine Bureau of Science in Manila and joined the ship for the first cruise during February–March 1908. We have no direct evidence that his participation extend-

[2] Images of 15 color paintings by Kumataro Ito can be found on the World Wide Web page of the National Museum of Natural History, at the following internet address: http://www.nmnh.si.edu/vert/albatross/albatross.html

ed beyond that. The *Albatross* log[3] reported that Barrows arrived on 19 October 1908, while the ship was in Hong Kong. We presume that he stayed on for the remainder of the expedition, as the ship's log does not mention his departure. We do know that Andrews participated only in the last cruise, from November 1909 to January 1910. It is reasonable to assume that Chamberlain, the ship's Resident Naturalist, would have served as chief scientist during the latter phase of the expedition, and we further assume that he served for the duration of the expedition.

By October 1908 repairs had been completed, and the *Albatross* left Hong Kong to begin what can be considered the second half of the expedition. From Hong Kong she went to Pratas Reef, an isolated outcrop beyond the continental shelf off the coast of China, then to waters off southern Taiwan, the Batanes and Babuyan Islands, northern Luzon, and back to Manila (Fig. 5) by the end of November, almost exactly a year from the day she had first arrived in the Philippines. During the following year, she undertook seven cruises. The first six completed the survey of the Philippines proper, and the last extended the exploration south through the Dutch East Indies, around the island of Suluwesi and up the east coast of Borneo (Fig. 6, 7).

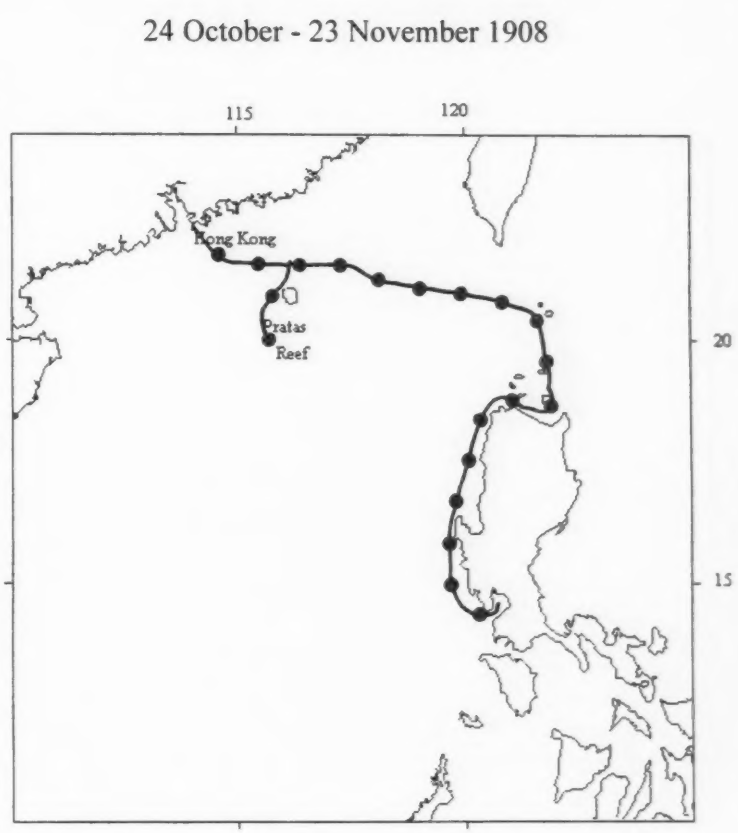

Figure 5.—Cruise from Hong Kong to Manila, October–November 1908.

During this last cruise, the grand finale of the expedition, Roy Chapman Andrews joined the ship. Andrews is best known for his central Asian expeditions during the 1920's, especially the discovery of the first known dinosaur eggs, in the Gobi Desert, but he began his scientific career studying marine mammals. It was his work on whales that brought him to the attention of the Bureau of Fisheries, and with it an invitation to join the Philippine Expedition. In 1909, Andrews was 24 years old, a doctoral candidate at Columbia University working his way up the ranks at the American Museum of Natural History in New York City, literally: his first job at the museum was cleaning floors, and eventually he would become its director. He was also a prolific writer and included a segment about the *Albatross* cruise in his autobiography "Under a Lucky Star" (Andrews, 1943). This and Bartsch's article in *Copeia* seem to be the only narrative accounts of the expedition that were ever published.

In June 1909, the director of the American Museum, H. C. Bumpus, called Andrews into his office and asked him if he would like to go to Borneo. To Andrews, the question was hardly worth asking. "It was ridiculous," he wrote, "to ask me if I wanted to go anywhere. I wanted to go *everywhere*. I would have started on a day's notice for the North Pole or the South, to the jungle or the desert. It made not the slightest difference to me" (Andrews, 1943:50). To join the *Albatross* was a special honor. As Andrews put it:

> "The *Albatross* was the most famous ship of her kind afloat. No other exploring vessel was so well equipped for deep-sea dredging and her personnel had included some of America's most distinguished naturalists. To be numbered in that group was sufficient in itself even without the prospect of voyaging among the enchanted islands of the East Indies" (Andrews, 1943:50).

Needless to say, Andrews accepted. After a cross-country trip to Seattle, Washington he boarded a liner for Japan, and from there worked his way south via Hong Kong to Manila.

When Andrews arrived, the *Albatross* was still at sea, so to fill in the time usefully he had himself dropped off on a

[3] The ship's logs are filed with U. S. Navy records at the National Archives, Washington, D.C.

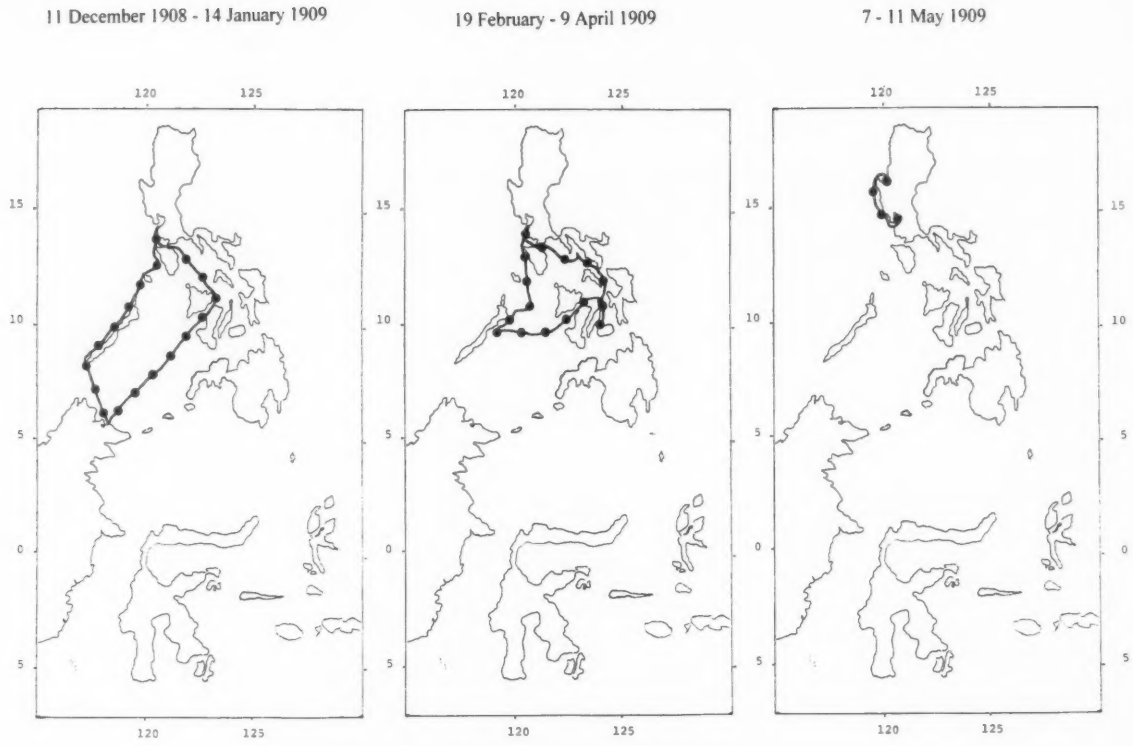

Figure 6.—Cruises from December 1908 to May 1909.

small uninhabited island along with two Filipino assistants for a week of collecting birds and small mammals. The week turned into 2 weeks when the boat that was supposed to pick him up failed to arrive on time. He returned in time to join the *Albatross* in Manila, however, and was greatly impressed by what he found:

> "She was a beautiful ship, built like a yacht, with a wide afterdeck where the officers slept on camp beds when the night was hot. It seemed almost a dream when I awoke the first morning in the brilliant flush of a tropic dawn to hear the boatswain's silver whistles piping the men to quarters on half a dozen warships riding at anchor a few fathoms away" (Andrews, 1943:66).

Andrews brought a fresh perspective to the enterprise, and although his enthusiasm was boundless, he could not fail to notice the darker side of things. The *Albatross* was known in the U.S. Navy as a "bastard" ship; although she was crewed by officers and men of the regular Navy, she was owned and operated by the U.S. Bureau of Fisheries. This led to an unavoidable culture gap. To the scientists, service on the *Albatross* was an honor and a highlight of their careers. To the Navy officers, by contrast, it was not a popular assignment, since it was not viewed as something that would advance their careers. Furthermore, noted Andrews, "It wasn't a 'happy ship.' Most of the scientific staff as well as the officers had been aboard her too long and friction had developed to such an extent that several were not on speaking terms with the others" (Andrews, 1943:67). Unfortunately, he did not mention names, and we are left to guess who was not speaking to whom. Andrews himself got off on the right foot when he joined the ship's baseball team. The executive officer, Lt. B. G. Barthalow, had been a pitcher at the Naval Academy. He was so good that nobody on board could handle him behind the plate. They needed a catcher, and Andrews, who had played baseball at Columbia, volunteered. With Andrews filling the missing link, the *Albatross* team played and beat the team from the Admiral's flagship. From then on, Andrews was on good terms with the officers and men.

Everything was new and exciting to Andrews. His job was land collecting, but he was fascinated as well by the material brought up by the deep-sea trawls. "In those waters, blue as indigo, she dropped her nets sometimes a mile, or even two, straight down to the ocean floor." The mass of mud would be dumped on deck and washed away, revealing creatures he had never seen before. "There were fish with eyes far out on stalks; others bearing phosphorescent spots along the sides like the glowing portholes of a lighted ship; fish

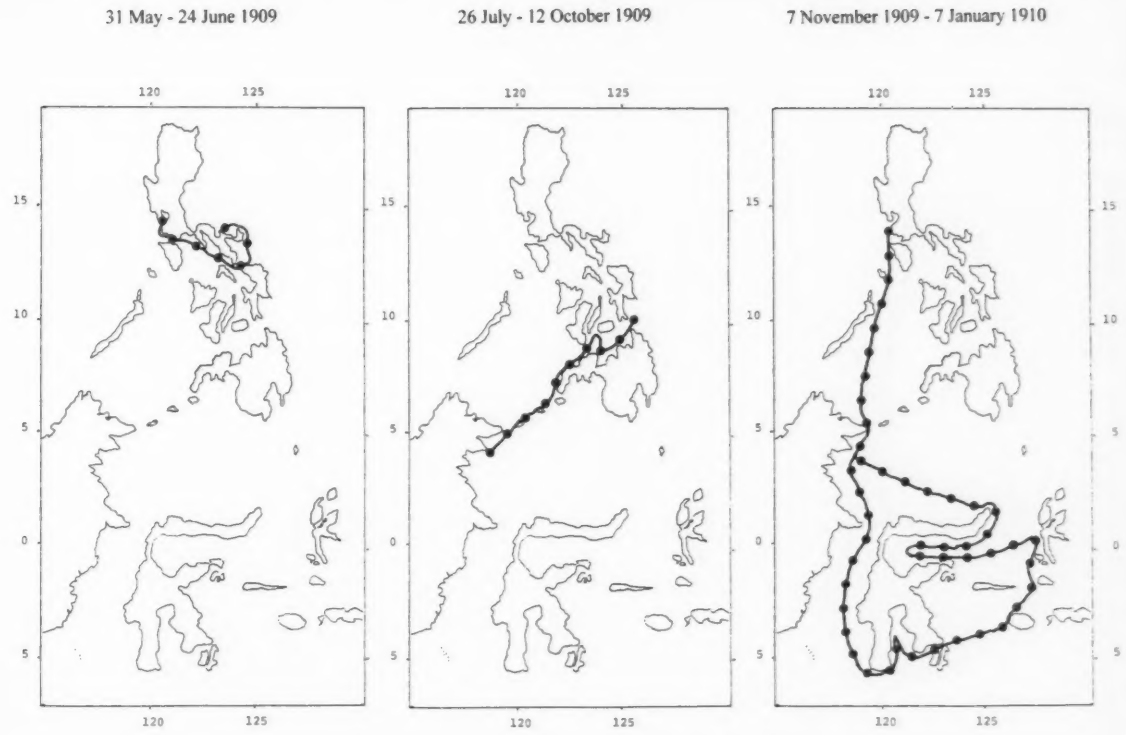

Figure 7.—Cruises from May 1909 to January 1910.

carrying little lanterns in front of their noses to light the way. Sometimes in the sudden ascent to the surface and release from the terrific pressure they were turned almost inside out" (Andrews, 1943:71). On 4 December 1909, the *Albatross* anchored at Ambon, where she would spend the next 4 days. Andrews described how he went ashore and found a deep canyon where he collected birds and small forest animals:

> "A flock of hornbills flew overhead making a noise exactly like airplanes. . . . I shot a huge lizard lying on a branch over a deep pool from which I collected several fish of a new genus. And then in the late afternoon...I climbed to the top of a hill where the bay and town lay spread out before me like an aerial photograph" (Andrews, 1943:74)

Andrews was clearly enchanted by the picturesque native villages he visited and by the friendliness of those he met. The only sour note occurred on the island of Buro. Landing there, accompanied by two sailors, he found only deserted huts. Still-burning fires and half-eaten food indicated that the village had been suddenly and recently abandoned. Following a stream into the jungle they found more settlements, all eerily empty. He felt the presence of "unseen eyes peering from the jungle," but "never could we catch sight of a human being." Returning along the trail, Andrews, his suspicions aroused, stopped to examine it closely. He found sharpened bamboo stakes, "probably poisoned, set at an angle along the trail, so they would jab us in the thighs" (Andrews, 1943:75). They abandoned the path and returned to the coast along the stream bed.

On Christmas Day, 1909, he went on a crocodile hunt in Makassar with the governor, the captain, and the ship's doctor. The doctor was the only one who got a shot at one, but he only hit it in the tail. The enraged reptile flung itself off the bank onto the outrigger of the doctor's canoe and charged with its mouth open. The doctor managed to place the muzzle of his rifle between the crocodile's jaws and pulled the trigger. This time, the animal died.

On 7 January 1910 the *Albatross* returned for the final time to Manila Bay. After a couple of weeks of rest, recreation, and resupply, she sailed away for the last time, heading north to Japan. The plans originally called for further collecting around Taiwan and the Ryukyu Islands, but persistent bad weather and other problems cancelled most of these operations. On 30 January, the ship herself was very nearly cancelled. Leaving the port of Soo Wan, Taiwan, the *Albatross* sailed straight into the teeth of a typhoon. Weather had been bad for some time, but without any of the technology we take for granted today—indeed without even a

radio—there was no way to know what was coming. Andrews (1943:77–78) described the scene in graphic detail:

> "The *Albatross* was headed directly into the seas which broke over the bow and swept the deck every time the ship dived into one of the mountainous green waves. A mile away, sheer cliffs rose like a wall above a narrow beach, smothered in white foam. For some reason, the captain had decided to fight his way against the rising storm instead of riding it out in the open sea. Keelung was only twenty miles way, but often we barely held our own. Foot by foot, the old ship crept forward, sometimes losing more than she gained, but always coming back for another assault upon the crushing waves. There was something distinctly personal about the fight. It was man against nature. Everyone on the ship was a part of the battle. I don't think I was frightened; no one seemed to be. All our minds and hearts and strength went out to help the *Albatross* when she staggered drunkenly after a smashing blow in the face."

As daylight ended, the ship finally made it through the entrance to Keelung harbor. The next day, Andrews discovered why the captain had been so determined to get into the harbor. While steaming to the inner anchorage, the starboard engine died. If that had happened the previous day, the ship probably would not have survived.

After a week at Keelung for repairs, the *Albatross* resumed her northerly course, stopping briefly at Okinawa and finally at Nagasaki, where the expedition ended. From there, she headed eastward across the Pacific, steaming under the Golden Gate and into San Francisco Bay on 4 May 1910, 2½ years after departing. The final tally shows that during the expedition, she had made 487 bottom trawls, 272 dynamite stations, 117 tows with pelagic nets, 102 seine hauls, 75 night-light/dip-net stations, 17 gillnet collections, 6 poison stations (using copper sulfate in tide pools), 3 traps, and 1 handline. In addition, many specimens were purchased in markets or from local fishermen. This does not include all the terrestrial collections of birds, mammals, reptiles, various invertebrates, and plants. In addition, data were collected on fisheries all over the islands. This enormous wealth of material now had to be worked up and reported upon. In this sense, the work of the expedition was just beginning.

The Fish Collections

It is difficult to get an accurate estimate of the number of fishes that were actually collected on the Philippine Expedition. Paul Bartsch (1941:211) mentioned 400,000. This figure has been repeated, but with little effort to substantiate it. Papers that accompanied the main accession into the U.S. National Museum mention approximately 100,000. Unfortunately, about a third of the collection in the Division of Fishes, National Museum of Natural History, has not yet been entered into the computer database. Even more unfortunately, this includes the bulk of the marine perciforms, which constitute much of the Philippine material. Hence, we cannot do a simple computer search. All of the material seems to have been ledger cataloged, however, and this affords us a method of getting at the numbers.

There are 28 ledger books that were entered after 1908, which is the earliest that any of the material from the cruise could have been returned. Each ledger contains about 5,000 catalog numbers. By going through these books page by page, we were able to compile the number of lots (a lot usually consists of one species collected at one time and one place) of fishes from the *Albatross* Philippine Expedition. Our total is 27,404 cataloged lots, including 1,291 type lots. Using an estimate of between three and four specimens per lot, this brings us easily to 100,000, which is probably close to the real number. An unknown factor is how much material was exchanged with other museums, but it is unlikely that this could change the total by much; certainly, it is difficult to conceive how the number could be increased to 400,000. At any rate, 27,404 lots represent between 7 and 8% of the entire cataloged collection in the Division of Fishes today. The 1,291 type lots represent about the same percentage of total type lots (17,323). At the time the last of the Philippine material arrived in Washington, around 1910, the entire cataloged collection in the museum totaled fewer than 70,000 lots. In other words, the fishes from the Philippine Expedition equaled nearly 40 percent of the entire existing collection!

The Bureau of Fisheries desired to keep the collection together to be studied and published as a unit. Space was provided at the Smithsonian Institution for storage and study, and this space seems to have been in regular use during the years immediately following the return of the expedition. The National Museum's Annual Report for 1913 (Rathbun, 1914:59) notes that "Dr. Hugh M. Smith, U.S. Commissioner of Fisheries, and Mr. Lewis Radcliffe, of the Bureau of Fisheries, made constant use of the collections in connection with their researches on the fishes of the Philippine Islands." Between 1911 and 1913, Smith and Radcliffe, either separately or in collaboration, published 12 papers in the Proceedings of the United States National Museum describing various groups of fishes from the expedition (Smith and Radcliffe, 1911, 1912; Radcliffe, 1911, 1912a, b, c, 1913; Smith, 1912a, b, c, 1913a, b). Smith published an additional short note in the Proceedings of the Biological Society of Washington (Smith, 1917). These barely scratched the surface of the immense collections, however, and other aspects of their official duties took up more and more of both Smith's and Radcliffe's time. Smith was promoted to U.S. Commissioner of Fisheries (head of the Bureau of Fisheries) in 1913, and Radcliffe was given additional responsibilities of his own. Then in 1923, Smith resigned his position and went off to Thailand. Before leaving, he had the collections formally transferred to the Smithsonian. At this point, the Bureau of Fisheries ceased to be the caretaker of the Philippine collection.

Responsibility for the collection now fell to the Assistant Curator of Fishes at

the National Museum, Barton A. Bean (there was no Curator of Fishes during this period). Bean was the younger brother of Tarleton Bean, longtime collaborator with G. Browne Goode and coauthor of their classic "Oceanic Ichthyology" (Goode and Bean, 1896). Although at one time Tarleton Bean had been listed as "Honorary Curator" of fishes at the Smithsonian, he spent the years after the turn of the century working on fish culture in New York.

Barton Bean had first come to the Smithsonian in 1881 and had gradually worked his way up from Aide to Assistant Curator. Although he was never promoted to full Curator, he functioned in that role for much of his career. Barton Bean was by all accounts a man of distinctly limited talents, and his shortcomings were compounded by an abrasive personality. Leonard Schultz, Curator of Fishes from 1938 to1968, described Bean's tenure as a period of stagnation (Schultz, 1961:121); others used harsher words. Certainly, compared to the 19th century, when the U.S. National Museum was home to such men as Goode, Spencer Baird, Tarleton Bean, and Theodore Gill, the first part of the 20th century seems like the Dark Ages.

Still, Bean appears to have taken his responsibility seriously, and when he found a job he knew he could not do himself, he recruited someone who could. In this case, it was the prolific Henry W. Fowler of the Academy of Natural Sciences of Philadelphia. Indeed, in the entire history of ichthyology, Fowler is probably the only individual who could have been expected to take on a job of this magnitude and actually complete it. In 1918, Bean had persuaded Fowler to work up the fishes of the Wilkes Expedition. Fowler dutifully turned out a manuscript of some 750 pages, which, for one reason or another, was never published.[4] He ultimately published a condensed summary on his own (Fowler, 1940).

Bean first mentioned the Philippine collection in a letter to Fowler dated 15 February 1921:

> "I have inherited the vast Philippine collections for their safety, but cannot say who will work them up. I unofficially told Dr. Smith what you and I can do, but he did not commit himself; it is an enormous collection, and if taken now can be fairly well preserved. Great quantities of duplicates in the lot. . . ."[5]

The wheels must have turned very slowly, for on 6 March 1925, Fowler sent this plaintive question to Bean. "Do you have any hope for me with the Philippine problem next fall or has it entirely fallen through?" It had not fallen through, however, and Fowler was shortly notified that it was agreed to have him work up the collection. In an undated letter, which must have been written in early to mid-March, Fowler wrote the following to an unidentified recipient at the Smithsonian, possibly Bean himself:

> "Dear Sir, In accordance with your suggestion I have made a rough survey of the Philippine Fishes. It is evident that the Pomacentridae, Labridae and Callyodontidae form a natural bloc which could readily be studied together. The last family is represented by about 3 barrels as they are large, and these with most of the Labridae could be studied best here in the museum [i.e. Philadelphia]. As an estimate $700 would seem to be a fair price for the work and I am therefore prepared to offer that bid for the work".[5]

On 24 March Fowler received official confirmation from the Administrative Assistant to the Secretary of the Smithsonian Institution:

> "Dear Dr. Fowler: I beg to enclose herewith an official order for the working up of three families of Philippine fishes, which is in accordance with your proposal of March 21, 1925. We are very glad indeed that you have been able to undertake this work, and it is hoped that you can begin at an early date. Any additional assistance that will be required beyond that rendered by Mr. Bean and the other employes [sic] in the division will be cheerfully furnished you".[5]

The official order, No. 70375, called for "making a systematic study of 3 families of Philippine fishes in the National Museum, comprising about 15,000 specimens; arranging the collection into three distinct sets, for facilitating their study, etc. furnishing complete report on above collection, suitable for publication by the National Museum."[5] Fowler, incidentally, charged extra for illustrations, and the Smithsonian was supposed to supply him with writing paper. Periodically Fowler would write to Bean saying that he was out of paper and please send him 500 or 1000 sheets, which Bean promptly provided.

On 26 April 1925, six barrels of fishes arrived in Philadelphia, and the work began. The manuscripts were to be published in several volumes of Bulletin 100 of the U.S. National Museum, which would contain the papers relating to all the organisms collected on the *Albatross* Philippine Expedition. The first volume appeared as Volume 7 (Fowler and Bean, 1928), and covered the Pomacentridae, Labridae, and Callyodontidae (= Scaridae). Volume 8 (Fowler and Bean, 1929) treated the Caproidae, Scorpidae, Monodactylidae, Platacidae, Ephippidae, Toxotidae, Scatophagidae, Chaetodontidae, Acanthuridae, and Siganidae. Volume 10 (Fowler and Bean, 1930; volume 9 was not on fishes) covered the Amiidae (= Apogonidae), Chandidae, Duleidae (= Kuhliidae), and Serranidae. Volume 11 (Fowler, 1931) treated Pseudochromidae, Lobotidae, Pempheridae, Priacanthidae, Lutjanidae, Pomadasyidae (= Haemulidae), and Teraponidae. Volume 12 (Fowler, 1933) dealt with Banjosidae, Lethrinidae, Sparidae, Girellidae, Kyphosidae, Oplegnathidae, Gerreidae, Mullidae, Emmelichthyidae, Sciaenidae, Sillaginidae, Arripidae, and Enoplosidae.

[4] Unpublished manuscript located in the Smithsonian Institution Archives, Record Unit 7180.

[5] Correspondence between Bean and Fowler is on file in the Smithsonian Institution Archives, Record Unit 213, Division 2.

The first five volumes were published in rapid succession, but after that the process began to slow. By now, the country was in the Depression, and one of its casualties was Barton Bean. On 8 July 1932, Fowler received a letter from an unidentified correspondent at the Smithsonian: "The reason I am writing you is, as you have probably heard, due to the recent enactment of the economy bill which automatically retires all employees over retirement age. This caught Mr. Bean, and several others in the Museum." [5] Whether through lack of money or the lack of an active participant at the Smithsonian, the project languished. Hugh Smith returned to the museum from Thailand in 1935 but appears to have taken no further hand in the fate of the Philippine fishes. He was plainly preoccupied with writing his monograph on Thai fishes (Smith, 1945). In 1933, George S. Myers was hired as the new Assistant Curator of Fishes at the Smithsonian. He brought great energy to his brief tenure, but he had never had anything to do with the Philippine Expedition and found his time fully occupied in bringing the Division of Fishes up to standard. Three years later, Myers departed for Stanford University, and Leonard P. Schultz became the new Assistant Curator (later promoted to Curator). Like Myers, Schultz felt no special responsibility for the Philippine manuscripts and soon was busy with his own projects. Volume 13 (Fowler, 1941) was not published for another eight years, and it was the last full treatment that ever appeared. Six additional manuscripts have lain unpublished to this day.[6] Fowler (1934, 1938, 1943) extracted some of the new species and published them separately.

Conclusion

And so the story of the great *Albatross* Philippine Expedition ends on an incomplete note. The ship is long gone, as are the men who sailed on her. Like Douglas McArthur's "Old Soldier," the *Albatross* just faded away into the mists of history. Decommissioned in 1921 and sold to an organization that operated her as a school ship, she was seized in Germany in 1928 and held for nonpayment of wages (Hedgepeth, 1945:13). After that, all record of her is lost.

Hugh Smith served with the U.S. Bureau of Fisheries for another 13 years after returning from the Philippines, then in 1923 resigned and went to Thailand to study the fishes and fisheries there. This ultimately resulted in his posthumous monograph, "The Freshwater Fishes of Siam or Thailand" (Smith, 1945).

Paul Bartsch returned to a long and distinguished career at the Smithsonian. He participated in many more expeditions, principally in Cuba and the Caribbean, keeping voluminous notes on each.

Roy Chapman Andrews left the *Albatross* in Nagasaki, Japan and stayed on to study whales and see as much of the world as he could before returning to New York. He fell in love with Asia and spent much of his career exploring the unknown interior of China and Mongolia. He wrote about his travels and shared with his readers the excitement of exploring unknown territories and making new discoveries. His books inspired many a young boy to learn more of the fascinating world he described and try to follow in his footsteps—among them the senior author of this paper.

Barton Bean lived on in retirement for another 15 years, ignored and virtually forgotten by the ichthyological community in which he had worked for so many years; he finally died at the age of 87 in a fall from a bridge.[7] Henry Fowler lived to exactly the same age, continuing his productive career without letup, working and publishing almost up to his death in 1965.

What remains as a permanent legacy of the *Albatross* Philippine Expedition are the magnificent collections. Even today the fishes and other organisms are a living resource, providing grist for scientific papers still being published.[8] Perhaps never again will a single oceanic expedition return so much valuable material.

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[6] Fowler's unpublished manuscripts are held in the Smithsonian Institution Archives, Record Unit 7180.

[7] Washington Sunday Star, 20 July 1947.

[8] Photographs of some of the specimens from the Philippine Expedition, as they appear today, can be found on the World Wide Web site of the National Museum of Natural History, at the following internet address: http://www.nmnh.si.edu/vert/albatross/albatross.html

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Kumataro Ito, Japanese Artist on Board the U.S. Bureau of Fisheries Steamer *Albatross* During the Philippine Expedition, 1907–1910

VICTOR G. SPRINGER

Introduction

The U.S. Bureau of Fisheries Steamer *Albatross*, commissioned in 1882, was probably the first large vessel built by any country specifically for marine research[1]. In 1907, by direction of President Theodore Roosevelt[2], it undertook its longest assignment: a 2½-year cruise to explore the fishery resources of the Philippine and neighboring islands. Just 2 years earlier, in 1905–06, the Bureau had published a monumental 3-volume study, including many colored plates of the marine organisms collected by the *Albatross* in the Hawaiian Islands in 1901 and 1902[3]. No doubt, Hugh M. Smith[4], Deputy Commissioner of Fisheries from 1903 to 1913, who was to direct the Philippine expedition, hoped to publish a similar study of Philippine organisms.

At the time of the Philippine expedition, photography had become an established source for documentation in many fields, but photographs of fish specimens for systematics purposes were published infrequently as compared with drawings. Most probably this can be attributed to the difficulty of obtaining good photographs and reproducing them in print. Additionally, color photography in anything like the form we know it had not yet been invented, and only an artist could capture the vivid, ephemeral colors of fresh-caught fishes and other marine organisms. As was often the case with natural-history expeditions of the 19th and early 20th centuries, an artist was assigned to accompany the *Albatross* during the Philippine Expedition and to prepare illustrations of any strange or new organisms that might be obtained.

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ABSTRACT—Kumataro Ito produced hundreds of beautiful color paintings of fishes and invertebrates during and after the 1907–10 Philippine Expedition of the U.S. Bureau of Fisheries Steamer Albatross. *The paintings are housed in the files of the Divisions of Fishes and Mollusks, United States National Museum of Natural History, and Smithsonian Institution Archives, Washington, D.C. Few of those paintings have been published in color, but many have been published in black and white. Two years after the expedition, Ito came to Washington, D.C., in 1912 for an extended period to render final paintings based on preliminary color sketches made during the expedition. He did not completely render all the sketches during his stay, probably because he was asked to produced a large number of black-and-white illustrations of Philippine fishes, and a few of North American fishes. Most of the black-and-white illustrations have been published. Few publications containing Ito's Philippine and North American illustrations have acknowledged him. The very little that is known about Ito's life is discussed, examples of his black-and-white and colored fish paintings are reproduced, and his previously unacknowledged illustrations in various publications are herein acknowledged.*

Another Japanese artist, Yasui, about whom almost nothing is known, joined the Albatross *during Ito's second tour on board the ship. It appears, with few exceptions, that Yasui produced only preliminary color sketches of fishes, which, if rendered as final paintings, were done by Ito.*

[1] This and similar variously qualified assertions regarding the *Albatross* have become unchallenged common currency in the literature (Coker, 1947; Hedgepeth, 1945, 1947, 1974; Nelson, 1971; Hobart, 1995; Dunn, 1996). The *Albatross* was built and commissioned by the U.S. Commission of Fish and Fisheries, an independent government agency, whose first head (Commissioner) was Spencer F. Baird (3 Feb. 1823–19 Aug. 1887). Baird held the position of Commissioner, beginning in 1871, concurrently with his position as Assistant Secretary, and later appointment as Secretary, of the Smithsonian Institution, until he died. The idea for building a large vessel specifically for oceanographic research was Baird's, and he was responsible for convincing the U.S. Congress to appropriate the funds. The Commission became the Bureau of Fisheries within a newly created Department of Commerce and Labor on 1 July 1903. The original organization has undergone several name changes. The present-day designation of the original U.S. Fish Commission, as it is most frequently referred to in the literature, is the National Marine Fisheries Service (NMFS), now a part of the National Oceanic and Atmospheric Administration, U.S. Department of Commerce.

[2] Letter dated 17 September 1907, from O. S. Straus, Secretary, Department of Commerce and Labor, to V. H. Metcalf, Secretary of the Navy: "The fisheries steamer ALBATROSS is about to undertake, at the desire of the President, a scientific expedition to the Philippine Islands . . ." The ship's logs for 1907–10, among those for other years, and some related records, including the original of this letter, are filed with the U.S. Navy records, rather than those of the Fish Commission, at the National Archives, Washington, D.C. Roosevelt appears to have had an abiding interest in natural history (Jordan, 1922, "Natural History was Roosevelt's first love . . . his last enthusiasm"). Roosevelt also ordered the *Albatross* to the Hawaiian Islands for the expedition mentioned in my text, and Jordan (1922) credits him with overiding objections of the government committee on publication to have the color plates of Jordan and Alvin Seale's, "The Fishes of Samoa," (1906) published.

[3] *Bulletin of the United States Fish Commission For 1903*, vol. 23, pt. 1–3.

[4] Hugh McCormick Smith, 21 November 1865–28 September 1941. For biographies of Smith, see Schultz (1941) and Anonymous (1941); for general comments about Smith and the expeditions, see Bartsch (1941), Hildebrand (1941), and D. G. Smith and J. T. Williams (1999).

Ito Selected

The artist Smith chose was Kumataro Ito[5], a resident of Tokyo. During the expedition, Ito produced well over 200 magnificent color paintings, mostly of fishes[6] (e.g. Plates 1–4). Most were to be stored in filing cabinets in the Division of Fishes, National Museum of Natural History, Smithsonian Institution, and hidden from view during Ito's lifetime and for many years thereafter.

Why Smith selected Ito rather than an American artist for the expedition, and how he came to know him, can only be surmised. It may be that no American artist was available for the long cruise to and from distant seas. Japan is much closer to the Philippines than San Francisco, where the *Albatross* commenced the expedition, and a Japanese artist could return home relatively quickly if he so desired. It may also be that Japanese artists worked for lower wages than did Americans.

Smith had a kind of precedent for selecting Ito. The shorter *Albatross* Hawaiian expeditions of 1901 and 1902, led by David Starr Jordan[7], had used the services of two American artists (Jordan and Evermann, 1905:20, 31; Jordan, 1922 (2):87). After those expeditions, Jordan employed various artists to prepare additional illustrations for the reports on the Hawaiian fishes (Jordan and Evermann, 1905:31). Two of these artists, Kako Morita and Sekko Shimada, were of Japanese descent, although both were possibly American citizens or residents. Morita, at least, was in the United States as early as 1902, and both were here at least as late as 1912[8], the year Ito visited Washington, D.C. One may wonder if Jordan was introduced to them and to Kumataro Ito, during Jordan's first trip to Japan in 1900 (Jordan, 1922(2):4). If so, Jordan, who was undoubtedly well acquainted with Smith, may have recommended Ito to Smith.

It is most probable, however, that Smith was introduced to Ito on one of Smith's two trips to Japan prior to the Philippine expedition (Smith, 1909:8). Smith's first trip, which lasted 6 months, was made in 1903 (Schultz, 1941:196) and the second in late 1907, just before the Philippine expedition began. Otaki et al. (1903–07) published a study in which they acknowledged Ito and mentioned that he was formerly an artist in both the Fisheries Bureau and Fisheries Institute of the Japanese Department of Agriculture and Commerce.

By 1907, Ito was a well-known illustrator of fishes in Japan. He had painted all the fishes on the 24 large folio color plates issued with the publication by Otaki et al. (1903–07)[9], of which Smith was most probably aware. During the two trips, Smith had investigated Japanese methods of culturing goldfish (Smith, 1909:8) . His investigations resulted in the publication of a book on the subject that included among the illustrations, two halftone reproductions of colored paintings of goldfish " . . . made for the author in Tokyo, by K. Ito" (Smith, 1909:29, 33)[10]. It is unknown whether the paintings were made prior to or during the years of the Philippine expedition (Ito returned to Japan twice during the course of the expedition).

I have been able to find very little personal information about Ito. The earliest documented record of his existence that I have found is the 1903 publication of Otaki et al., which would certainly indicate that Ito had been active for some years earlier. The editor of the now defunct Japanese natural history magazine *Anima* wrote me in 1986 that a curator of the Tokyo National Museum determined that Ito was employed in 1881 as an illustrator of fish by the Department of Zoology of Tokyo University[11], and that Ito had studied painting under Gyozan Nakajima, a well-known artist of that period[12].

When Hugh M. Smith sent letters to Ito, he addressed them to Ito care of Kamakichi Kishinouye at the Japanese Imperial Fisheries Bureau, Tokyo[13]. Kishinouye was a prominent ichthyologist and is now best remembered for his studies on scombroid fishes. He also may have been the source of Ito's introduction to Smith. From 1903 until the *Albatross* reached Manila, Philippines, on 28 November 1907, I have no information on Ito.

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[5] Not to be confused with Keisuke Ito, Fisheries Department of Hokkaido, and president of the Fisheries Society of Northern Japan (see *Transactions of the American Fisheries Society for 1887*, p. 68). Keisuke Ito published on Japanese fisheries in American journals during the late 1880's under the name K. Ito (Dean, 1916). He is probably the K. Ito who wrote D. S. Jordan a letter in 1903 (Department of Special Collections, Stanford University Library, call no. 58, Jordan Papers, box 35, folder 347; P. Armstrong, in litt., 1997), which I initially, erroneously believed was written by Kumataro Ito, as it referred to [fish] breeding.

[6] Ito's fish paintings are scattered throughout the estimated 10,000 illustrations in the illustration files of the Smithsonian's Division of Fishes, and their exact number is unknown (an inventory is in progress under the supervision of Lisa Palmer). I have examined the *Albatross* color paintings and/or preliminary sketches of at least 200 different specimens of fishes (some finals were based on two specimens), presumably all those of the invertebrates, and many of the approximately 80 published black-and-white paintings done after the expedition, as well as some unpublished ones.

[7] David Starr Jordan (19 January 1851–19 September 1931), world-renowned ichthyologist and first president of Stanford University, needs no further introduction here.

[8] Based on examination of the Morita and Sekko [Shimada] correspondence in the David Starr Jordan Papers, Department of Special Collections, Stanford University Library, SC58, made for me by P. A. Armstrong, 1 April 1997.

[9] Ito also executed all the line cuts in the text, which feature fishing techniques and equipment. Very few copies of Otaki et al. (1903–07) appear to be present in the United States. The Library of Congress has the complete publication, which was issued in 12 parts: 6 thin, unbound, octavo-sized leaflets, each of which must have been accompanied by a simultaneously issued loose-leaf group-of-four folio-sized color plates. The plates are printed on acidic paper, and are very brittle. Although the species are recognizable, the quality of the illustrations suffers when compared with that of Ito's Philippine paintings.

[10] The book also contains the color reproductions of 10 goldfish paintings made by J. Urata that were also published in color by Matsubara (1910). The 10 paintings were originally prepared for Matsubara, who had copyrighted them and probably thought he would be the first to publish. See also footnote 43.

[11] Letter to author from Tokuichi Sawachika, 10 January 1986. I did not follow this lead in 1986, and my attempts and those of Japanese colleagues during 1997 to identify the curator or to verify the information about Ito have failed. The former editor cannot now recall his source for the information (E-mail to author from K. Matsuura, 8 January and 12 February 1997). Tokyo University was usually referred to as Imperial University of Tokyo prior to World War II.

[12] Isono Naohide, Dep. Biology, Keio Univ., Yokohama, provided me with information, including Japanese references, on Nakajima Gyozan [Japanese give the family name first], 1832–1914, whose original family and given names were Funabashi Kuwajiro.

[13] Smithsonian Institution Archives [SIA], record unit [RU] 106, box 8; RG 213, boxes 6, 8, 11.

Aboard the *Albatross*

The *Albatross* did not stop in Japan on its way to the Philippines[14], where both Smith and Ito joined the ship. One can infer from a letter dated 25 January 1908[15], written by Kishinoue to Smith, that Smith was in Japan and had departed Nagasaki by steamer for Manila on Smith's 42nd birthday, 21 November 1907. The *Albatross* anchored at Manila on 28 November, and according to its log, Smith boarded the ship there on 3 December, having arrived that day aboard (the presumably Japanese) steamer *Saphiro*[16]. Ito boarded the next day. I think it probable that Smith and Ito traveled together on the same vessel from Japan to Manila. On 28 April 1908, 5 months after joining the *Albatross,* Smith departed the ship and returned to Washington, D.C.[17], but Ito remained on board for 2 more months.

Frederick M. Chamberlain[18], who had published on the Alaskan salmon fisheries, was the Resident Naturalist aboard the *Albatross* during the entire Philippine expedition. In a letter to Smith, dated 5 July [1908][19], Chamberlain wrote disparagingly of Ito, "Mr. Ito left the 3rd [of July], being paid up to the 18th. He left all his fish sketches with me and the "nudis" [nudibranchs] with Bartsch. I still have a few finished plates—the rest were mailed some time ago. During the last few sketches he made, I checked his work pretty carefully. Either our eyes do not see alike or he has ideas on his own or his work needs a good deal of revision. Drawing as he did from single examples[20], he was bound to miss many things. In the event of his continuing with us later I think it would be an excellent plan to have all the pictures retouched. The more I see of Bleeker's[21] and Gunther's[22] plates the more I am convinced that a paper accompanied by *true* color drawings will be a novel and interesting issue." The word "true" is emphasized in the original. Although never spelled out, there seems to have been friction between Chamberlain and Ito during the entire expedition.

Smith's time with Ito before and during the early months of the Philippine expedition must have made a great impression on Smith. He was always highly solicitous of Ito, in no small part, perhaps, because Smith had the opportunity of seeing Ito's work and was probably thinking about a publication on the fishes. In what must be considered a slap at Chamberlain, Smith wrote Ito on 19 August 1908[23], shortly after receiving Chamberlain's letter, "I am very much obliged to you for the excellent work you did on the *Albatross* and for remaining on the ship beyond the time you had originally intended. The *Albatross* will be at Hong Kong undergoing repairs until about October 1 and I should be glad if you could rejoin the ship at that place and go with her to the Philippines for . . . 6 or 7 months. The Bureau will pay you $3.50 a day and your subsistence while on the ship. If you can accept this appointment, please notify me and also write to Mr. Chamberlain . . . ."

Smith also mentioned, for the first of what were to be several times, a subject he and Ito must have discussed on board the *Albatross*, "Referring again to . . . your coming to Washington, I should like to know whether you have reached any decision . . . If you come . . . after the conclusion of the work on the *Albatross* . . . you will have a pleasant time and plenty of work . . . you can count on receiving at least $5 a day, but you would have to pay your own living expenses out of this."

Return to the *Albatross*

After Ito's first departure from the *Albatross*, Chamberlain wrote Smith another letter, although I have not found a copy of it. In answer, Smith wrote Chamberlain at Manila on 6 October 1908[24], "Your letter of the 31st of August was received two or three days ago. I note that you write in regard to a Japanese artist to replace Ito, and have no doubt his employment on requisition under the terms you mention will be entirely satisfactory to the office." But there was no need for such action (see Addendum). Ito accepted Smith's invitation and returned to the *Albatross*, although I do not know the exact date. The *Albatross* logs are erratic and incomplete with regard to the arrivals and departures of the non-U.S. Navy personnel aboard. A cursory checking of the data associated with Ito's color paintings, which were based on fresh specimens, indicate that they include paintings of fishes after October 1908 that were collected at least as early as 11 December 1908, and more-or-less continuously from that date until 3 July 1909, when Ito departed the *Albatross* and again returned to Japan.

Before Ito left, Chamberlain gave him a written note asking Ito about preparing new drawings and making corrections to others, as well as com-

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[14] As derived from examination of the *Albatross* logs. See footnote 2.

[15] SIA RU 213, Division of Fishes, box 9, folder 4.

[16] Bartsch's journal for 3 December 1907. Paul Bartsch , 14 August 1871– 24 April 1960, was a curator in the Division of Mollusks, U.S. National Museum, and one of the scientific members on board the *Albatross* during much of the first year of the Philippine expedition. His journals, which comprise two diaries and one volume of handwritten scientific descriptions of nudibranch mollusks, together with Ito's preliminary sketches for each, are on file in the library of the Division of Mollusks.

[17] Bartsch's journal.

[18] F. M. Chamberlin, 29 June 1867–17 August 1921.

[19] SIA RU 7258, F. M. Chamberlain papers, box 1, book 2.

[20] Illustrations based on single specimens are to be preferred as they obviate the problem that an illustration may represent an aspect that does not exist in nature. Many of the final color paintings, especially those made of fishes collected during Ito's second and third tours, bear indications on the sketches that they are based on two or more specimens.

[21] Pieter Bleeker, 10 July 1819–24 January 1878, Dutch ichthyologist, most famous for his magnificent unfinished 9-volume folio "Atlas Ichthyologique des Indes Orientales Néerlandaises," 1862–1877, with 420 colored plates. Chamberlain appears to be referring to the Atlas illustrations. Where the same species are portrayed by both Ito and in the Atlas, I believe Ito's color is more accurate.

[22] Albert C. L. Günther, 3 October 1830 – 1 February 1914, born and educated in Germany, spent his ichthyological career at British Museum (Natural History). Chamberlain was undoubtedly referring to the color plates in Günther's "Andrew Garrett's Fische der Südsee," 1873–1881 [publication continued to 1910, with a hiatus between 1881 and 1910], and possibly R. L. Playfair and Günther's "The Fishes of Zanzibar," 1866. I strongly disagree with Chamberlain's assessment.

[23] SIA RU 106, H.M. Smith, 1908, box 8.

[24] SIA RU 213, Division of Fishes, box 6, folder 2.

menting on a contentious matter of issuing payments. In an undated note, apparently signed by Ito (Fig. 1), but written by someone else, Ito responded to Chamberlain, who forwarded the note to Smith[25] , "Mr. F. M. Chamberlain. Dear Sir: In reply to your note, I beg to make the following statements: 1. For pictures of 2 inches or less in length I can do the work for ten dollars . . . a piece, but it is desired to receive twenty dollars . . . a piece for paintings of fishes of more than 9 inches, for it takes much time to draw them in smaller sizes than the natural[26]. 2. As to the corrections to be made to the paintings finished on the Albatross; I think I have to ask one dollar per hour for such work. 3. I am much obliged to you for the kindness in having some exception made for me on the matter of payment. Hereafter it will be quite satisfactory for me to be paid once a month according to the usual custom. But for this time I hope to receive, if possible, the price for the 16 pictures, which have been finished. Yours respectfully, Kumataro Ito."

The two must have had strained relations to have communicated so formally, and these prices seem unreasonably high, especially considering that Ito was being paid only $3.50 a day and subsistence while aboard the *Albatross*. Ito apparently made quick color sketches (up to 6 in a day, see Addendum) and notes on freshly caught fishes and other organisms, probably rendering final paintings during periods when there was no collecting. During the total time he was on board the *Albatross*, which I estimate to be a maximum 16 months (about 480 days), he prepared the preliminary sketches of over 100 (perhaps as many as 200) fishes and the final paintings of many of them. In addition, he prepared all the preliminary sketches and finished paintings of about 70 nudibranch mollusks and 12 polyclad turbellarians, and the preliminary sketches of a few ctenophores, a sea cucumber, and a crab.

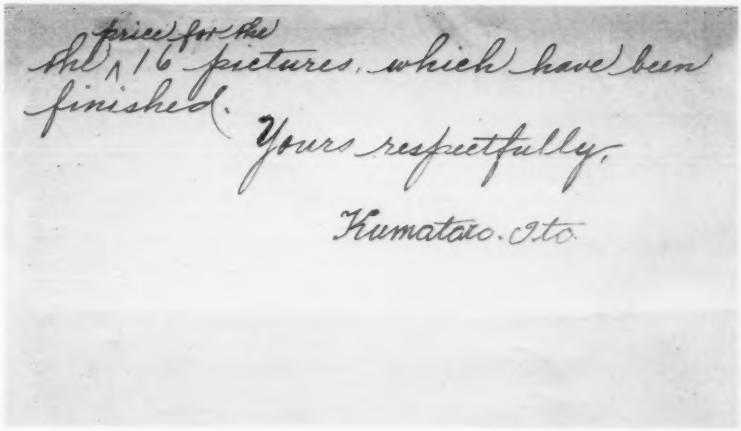
price for the
the 16 pictures, which have been
finished.
Yours respectfully,
Kumataro. Ito

Figure 1.—Above is the handwritten English signature of Kumataro Ito; at right is Kumataro Ito's name in printed Japanese Kanji characters.

伊藤熊太郎

All of his preliminary and final paintings of the nudibranchs and turbellarians exist in the files of the Division of Mollusks, U.S. National Museum of Natural History. Only the preliminary sketches, filed in the Smithsonian Institution Archives[27] exist for the other invertebrate organisms.

A Third Excursion

In a letter to Ito in care of Kishinouye in Tokyo, dated 4 August 1909[28], Smith wrote, "I have learned that you intended to leave the *Albatross* on July 2nd and return to your home. The cruise of the *Albatross* will soon be over, and the ship will start back home. She will first sail south of Borneo and touch at points in Celebes, Java, and Sumatra, then go to Singapore, thence to Formosa and the Riu-Kiu islands, and Japan. This trip will probably begin about October 1st, and Japan will probably be reached about January 1st [1910][29]. I write to ask whether you can join the vessel again for that cruise . . . If so, I shall be very glad . . . Please let me know, and also write Mr. Chamberlain . . . at Manila . . . I have never learned whether you intend to come to America. It would save you considerable expense if you came on the *Albatross*, although the trip would probably be rougher than on a larger vessel; and, as you could not work much on board, it is doubtful whether the Bureau

[25] Found attached to carbon copy of letter of 4 August 1909, from Smith to Ito; SIA RU 213, Division of Fishes, box 8, folder 8. The a's, o's, and r of the signature differ markedly from the same letters in the body of the note.

[26] Note that no prices are given for fishes between 2 and 9 inches.

[27] SIA RU 7260, box 3.

[28] SIA RU 213, box 8, folder 8.

[29] Smith was nothing, if not optimistic.

could continue your full salary during the voyage."

Smith must have been a charmer[30], or, perhaps Ito's home life paled quickly after each return, for Ito again accepted Smith's invitation, and was back on board the *Albatross* at least as early as 27 September 1909, based on an indication of a drawn specimen in the *Albatross* tin-tag register[31]. He also must have stayed on board for the trip back to Japan, for there are paintings of fishes collected in Taiwan (then Formosa) on 25 and 29 January 1910, almost a month after Smith had predicted the *Albatross* would arrive in Japan. But Ito did not continue with the *Albatross* back across the Pacific.

Ito in Washington, D.C.

Obviously warmed by his previous successes, Smith continued to press Ito after the expedition ended to come to Washington, D.C. On 17 June 1910, well after the *Albatross* had returned to San Francisco, Smith wrote to Ito in Japan[32], "There would seem to be at least one year's work on the sketches you made . . . and if you can come . . . for this purpose the Bureau will . . . give you steady employment for that length of time. Should you desire to remain longer there are several other groups of animals on which you can work in this Bureau or in the National Museum. There is a large number of Japanese in Washington and you would doubtless find many friends among them and not be so lonely as you were on the 'Albatross.' The office hours are comparatively short (9:00 a.m. to 4:30 p.m. . . .) and you would also be able to knock off work when you are so inclined. Your finished drawings make an interesting exhibit when brought together and . . . we could arrange for a public exhibition if you so desired. . . . I will place no one else on this work until I hear from you."

Ito again accepted Smith's invitation, and was in Washington at least as early as June 1912, but I have been unable to determine the length of his stay, which may well have lasted a year. He never finished rendering the preliminary color sketches made on the *Albatross*, but many are very good and a few have been published[33]. One reason Ito may not have finished the paintings is that he was asked to make new, black-and-white drawings of Philippine deep-sea fishes (e.g. Figs. 2 and 3) and North American fishes. Of more than 80 such that I believe were done during his visit, I have found only three that provide evidence for the timing of the visit[34].

Lewis Radcliffe[35] and Welsh (1913) described a new species of freshwater darter, *Hadropterus sellaris* (= *Etheostoma sellare*) they collected in Maryland on 4 May 1912. The paper, which contained an illustration of the holotype, was issued on 2 May 1913. The authors did not acknowledge Ito, although he was most certainly known to Radcliffe. The original illustration and any associated information it might have contained are now lost. The style of the drawing, however, is recognizable as that of Ito[36], as is that of the drawing of a now-synonymized new species of flounder, *Pseudopleuronectes dignabilis* (= *P. americanus*), described by Kendall (1912). It was caught off New England about 18 April 1912, and forwarded to Washington, D.C. (date of receipt not recorded). The reverse of the illustration of the specimen bears a Department of Commerce and Labor numbered requisition stamp dated 24 June 1912, and is unusual in bearing an old Bureau of Fisheries label with Ito's name typed in as illustrator. Kendall, however, did not acknowledge the illustrator. It seems improbable that there was enough time between 28 April and 24 June for the specimen to have been sent to Washington, D.C., studied, sent to Japan, illustrated, and returned to the United States (no planes were traversing the United States or the Pacific in 1912).

The third figure is a drawing of a now synonymized new species of cottid fish, *Triglops ommatissimus* (= *T. murrayi*), described by Charles H. Gilbert (1913). Gilbert, then professor of zoology at Stanford University, wrote a letter to the "Assistant Secretary, U.S. National Museum" on 17 May 1912, stating that he was presenting the "type" of his new species to the museum. He noted that

[30] By 1909 the *Albatross* had been operating for over 25 years and must have been quite a "tub." A reading of the logs during the Philippine expedition evidences a constant litany of ship and personnel problems. Crew members were constantly deserting and being thrown in the brig and placed on bread and water, one was killed by an exploding boiler, and on 16 November 1908, "Commanding Officer awarded following punishment: F. Meyerhoff CM3C, insolence and profane language to Naturalist F. M. Chamberlain, 8–12 P.M. watch on bridge for one week."

[31] See Addendum for discussion of tin-tag and linen-tag registers.

[32] SIA RU 213, nox 6, folder 2.

[33] For example, Schultz (1967, Fig. 2; 1969, pl. 4, Fig. D).

[34] Unlike many of the *Albatross* final color paintings, which are also represented in the files by preliminary color sketches, none of the black-and-white drawings I presume to have been made in Washington, D.C., are represented by preliminary sketches. I also assume that there was so much color sketching and final painting to be done on the *Albatross* that there would have been no time (or reason) for making drawings in black and white, especially of fishes that are colorful in life, such as that in Figure 3, which species is reddish and yellowish in life (Gloerfelt-Tarp and Kailola, 1984:116–117, as *Gagariscus prionocephalus*). These colors are lost quickly during specimen preservation.

[35] Lewis Radcliffe , 2 January 1880–10 September 1950 (based on a typewritten copy of a biography that appeared on page 2, Bulletin 5, 14 September 1950, Oyster Institute of North America, in files of ichthyologists' photographs, Division of Fishes, National Museum of Natural History). Radcliffe was assistant naturalist at the beginning the Philippine expedition, but departed the ship in 1908 about the same time as H. M. Smith.

[36] Ito's illustrations are readily recognized from the general appearence of the subject, the media, the thin rice paper used for the preliminary color sketches, the mouth (anatomy permitting), almost always illustrated as at least slightly open (usually more), and the eye rendered to include a pale, definitely triangular area radiating out from about midpupil towards the 10 or 11 o'clock position on the iris. Some of Ito's finished paintings have fine, flaked mica over the scales on the body of the fishes, clearly intended to impart a sheen. Powdered mica was applied occasionally to enhance the backgrounds of woodblock prints made by 19th century Japanese ukiyo-e artists (e.g. Utamaro), who may have originated the technique. Ito used it, not very successfully, on the plates of the 1931 publication by the Fisheries Society of Japan, "Illustrations of Japanese Aquatic Plants and Animals." Many of Ito's preliminary sketches bear remarks written in Japanese, and I have seen impressions of erased, similar remarks on some of the final renderings. Unlike almost all the original fish illustrations in the Division of Fishes files, those by Ito are additionally recognizable because they rarely contain any indication of who prepared them (see also Addendum for discussion of Yasui, another Japanese artist who was aboard the *Albatross* during Ito's second tour).

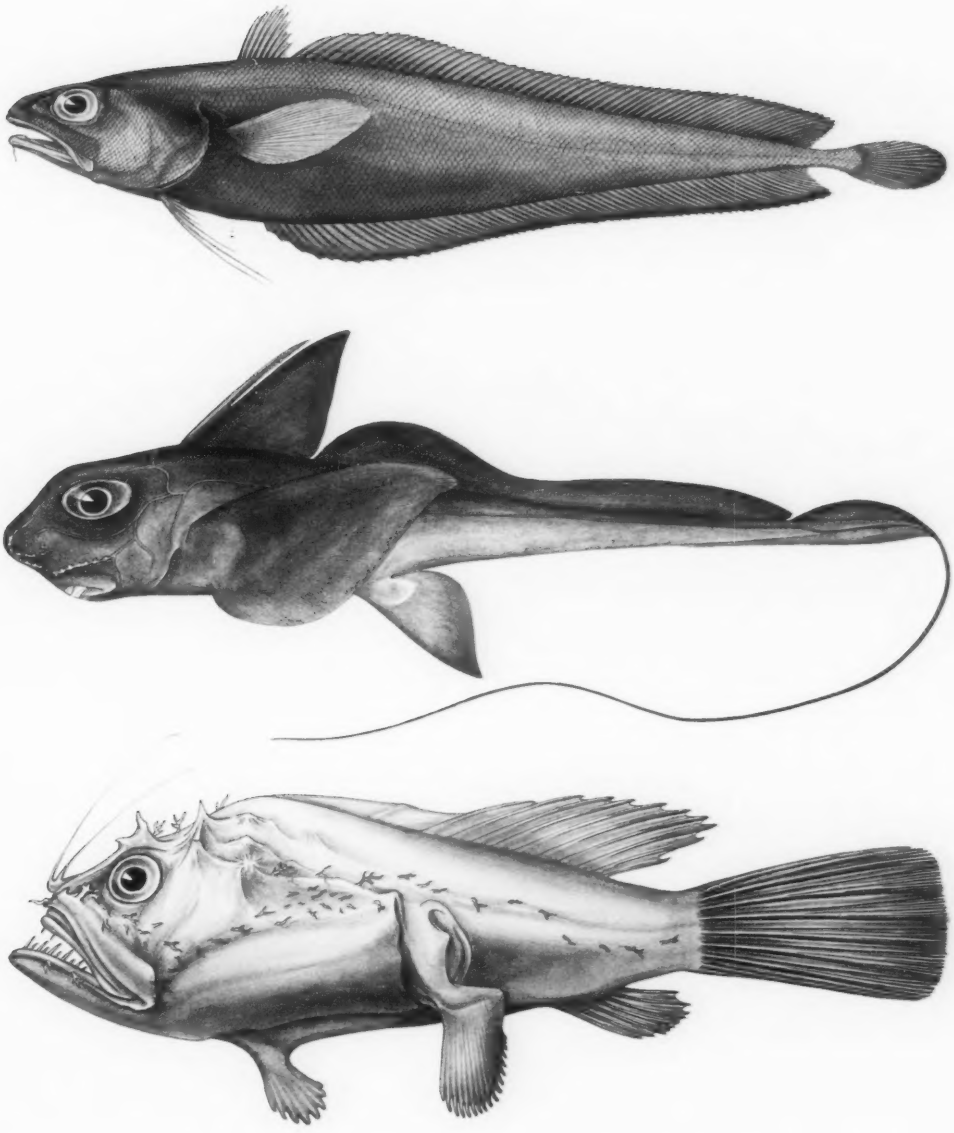

Figure 2.—Examples of previously published black-and white illustrations made by Kumataro Ito of deep-water fishes collected during the *Albatross* Philippine expedition. Top, *Physiculus nigrescens* (Radcliffe, 1912b:pl. 22, fig.1); Middle, *Hydrolagus deani* (Smith, 1912:pl. 29); Bottom, *Sladenia remiger* (Radcliffe, 1912a:pl. 42, Fig. 1).

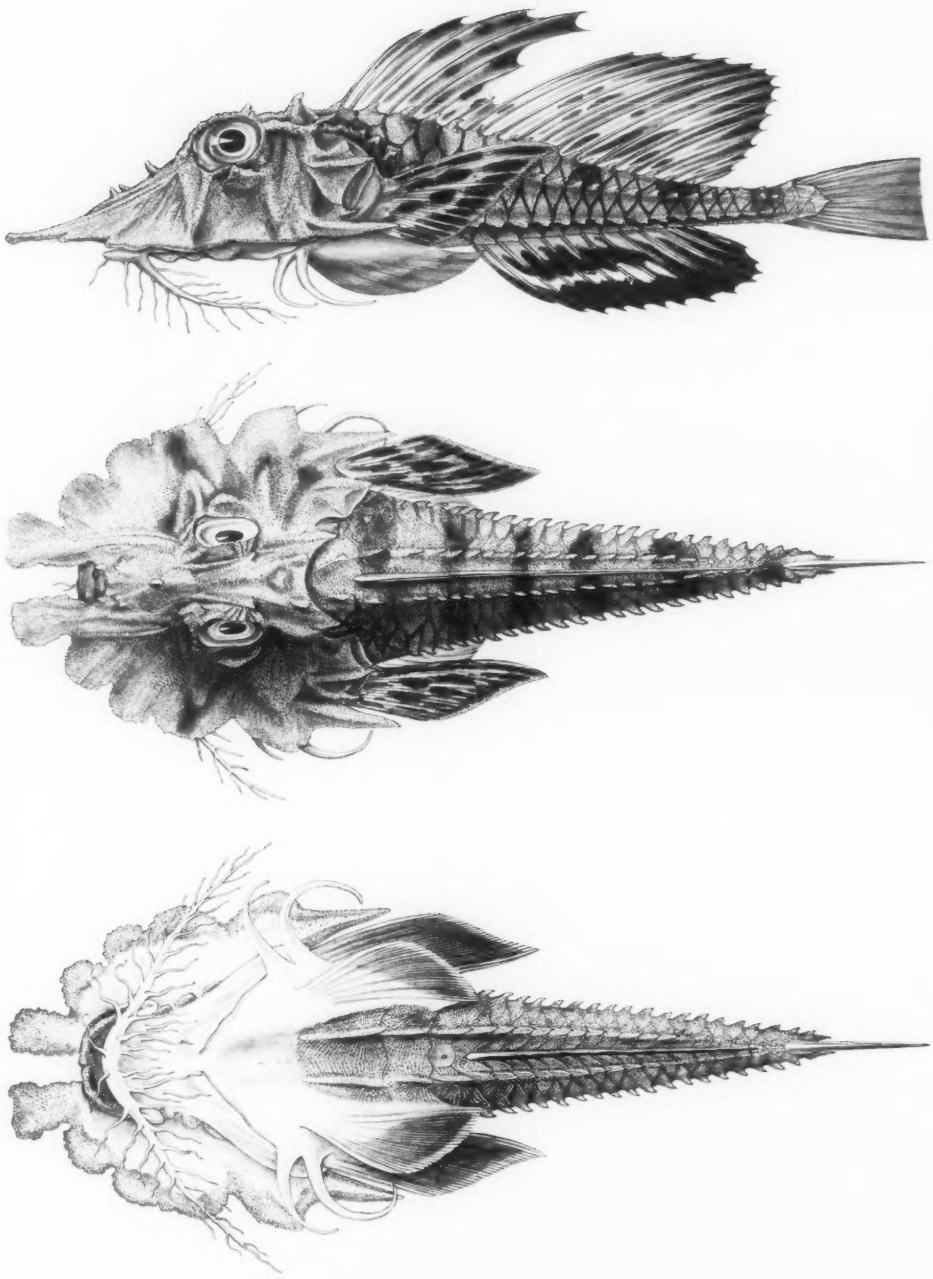

Figure 3.—Examples of previously unpublished black-and-white illustrations made by Kumataro Ito of deep-water fishes collected during the *Albatross* Philippine expedition. Holotype of *Gagariscus semidentatus* Smith, 1917 (= *G. prionocephalus* (Dumeril, 1839)), USNM 78250; lateral, dorsal, and ventral views.

his manuscript describing the new species would be forwarded within a few days and requested that the museum provide an illustration of the type to accompany the description, because Gilbert ostensibly did "not now command the services of an artist." Gilbert's letter was noted as being received on 22 May 1912, and forwarded to Barton A. Bean[37], then Assistant Curator of fishes at the museum, on 31 May (there was then no Curator of Fishes). On 13 June, less than 2 weeks later, Bean forwarded the completed drawing to the museum administation[38]. The drawing is another of the few that bears Ito's name. Gilbert, who may not have been apprised of the illustrator's name, did not acknowledge Ito in his publication.

Ito's Work Rarely Acknowledged

Radcliffe (1911:pl. 21, top figure) published the first of Ito's colored paintings, but it appeared only as a halftone. Following this, Radcliffe and Hugh M. Smith published seven other papers on fishes collected during the Philippine expedition (Radcliffe, 1912a, b, 1913; Smith, 1912, 1913a, b; Smith and Radcliffe, 1912). They contain at least 75 black-and-white illustrations that were almost certainly drawn by Ito during his time in Washington, D.C. In none of the eight publications is Ito acknowledged.

From 1913 to 1953, none of Ito's Philippine or North American illustrations appear to have been published, either in color or in black-and-white. In 1953, Randall (1956:pl. 3, upper figure) published the first color reproductions of Ito's paintings. The reproductions, four surgeonfishes, were each reduced from much larger originals to but 2.5 inches in length, and the color suffered considerably. Randall, probably unaware of Ito, acknowledged only the *Albatross* expedition as the source of the figures.

From 1953 to 1966, 57 of Ito's colored *Albatross* paintings were published as halftones in the three volumes of the "Fishes of the Marshall and Marianas Islands[39]," but attributed only to the "*Albatross* Philippine collection." Next followed Leonard P. Schultz[40] (1967:col. fig. 1, 2, 5), who published three of Ito's paintings in color, and then Schultz (1969), who reproduced 31 of Ito's paintings (including 2 preliminary sketches; 1969:pl. 1d, 4d) of parrotfishes in color. In both publications, Schultz attributed the illustrations only to the *Albatross* Philippine expedition. Greenfield (1974:Fig. 8, 17, 19, 20) published four of Ito's color paintings as halftones, mentioning only "courtesy of the National Museum of Natural History."

Kaburaki (1923:pl. 53–54), a Japanese scientist at the Imperial University of Tokyo, published Ito's colored polyclad turbellarian paintings in black and white, acknowledging only Paul Bartsch, for whom Ito had prepared the drawings.

Undoubtedly, the main reason Ito was so rarely acknowledged is that so very few of his illustrations indicate his name. But this does not excuse everyone, and particularly, Hugh M. Smith, Lewis Radcliffe, and Leonard P. Schultz. Smith (1909) had acknowledged Ito in Smith's book about goldfish. One can only wonder why he failed to do so afterwards.

For all the many fish and invertebrate paintings he did on board the *Albatross* and in Washington, D.C., the only scientific publications that acknowledge this work as Ito's are to be found in Pietsch and Grobecker (1987:Fig. 64, "Drawn by K. Ito.") and in five of the eight volumes of Bulletin 100 of the U.S. National Museum that treat the *Albatross* Philippine fishes. Remarkably, in none of the eight volumes is there an illustration drawn by Ito, but in two of the volumes, H. W. Fowler[41] and B. A. Bean (1928, 1929) state that the color notes incorporated in the text were based upon fresh specimens, which "in many instances were supplemented by [from?] color sketches made by K. Ito."

In the other three volumes, (Fowler, 1931, 1933; Fowler and Bean, 1930) of Bulletin 100, the reader is referred to the acknowledgments in previous volumes, but Fowler (1931:61) also described a new species, *Pempheris itoi*, which is the only species bearing Ito's name. Fowler remarked, "For K. Ito, in appreciation of his many color sketches of Philippine-East Indian fishes." Ironically, the figure of the new species accompanying the description was drawn by Fowler, but it is not a species Ito illustrated. In one of the earlier volumes, Fowler and Bean (1930:186) missed a golden opportunity. They described *Chorististium swalesi* (now *Liopropoma swalesi*) from two specimens collected on the *Albatross* expedition 19 November 1909. They gave no figure of the species nor did they describe its fresh coloration. Yet, Ito had prepared a final color painting of their holotype (Color Plate 1A), which Schultz (1953:pl. 32b) later published as a halftone. The illustration waited until 1988 to appear in color (Randall and Taylor, 1988:pl.1, Fig. A), but even then with-

[37] B. A. Bean, 21 May 1860 – 19 June 1947 (SIA RU 7098), was employed by the Division of Fishes, National Museum of Natural History from 1882 to 1932, and he was in charge for most of that period (Schultz, 1961).

[38] For these transactions, see U.S. National Museum of Natural History Registrar's accession file 54197.

[39] United States National Museum, Bulletin 202, vol. 1., 1953 (pl. 28b, 30c, 31a–c, 32a, 34b, 37a, 39a,b, 47a.b, 52a,b, 53a,b, 55a–c, 59b, 67, 68, 70, 73); vol. 2, 1960 (pl.79b, 81d, 82d, 91c,d, 94c,d, 95b–d, 96a,c, 97e, 98c, 101a–c, 102a–c, 103c,d, 109a–c, 112b,c, 118d); vol. 3, 1966 (pl. 141c,d, 146c, 148). The papers citing these figures are variously authored by L. P. Schultz, E. A. Lachner, L. P. Woods, and L. P. Woods and L. P. Schultz.

[40] L. P. Schultz, 2 February 1901 – 17 July 1986. Schultz was a curator in the Division of Fishes, National Museum of Natural History from 1936 to 1968. He made abundant use of the illustration files and Ito's paintings, but he seems to have acknowledged by name only those illustrators that actually worked directly for him. Although Ito was not among them, Schultz must have known who prepared the *Albatross* fish paintings. Additionally, Hugh M. Smith, was in residence in the Division during the last several years of his life while working on his book, "The Fishes of Siam, or Thailand," which Schultz (1945) completed after Smith's death. Schultz appears to have had a close professional, if not social, relationship with Smith (Schultz, 1941:201), and it would seem remarkable if the two men never discussed the Philippine expedition and its artist, who created the paintings in the files Schultz oversaw and Smith delighted in.

[41] H. W. Fowler, 23 March 1878 – 21 June 1965, was employed all of his professional life, beginning in 1894, by the Academy of Natural Sciences of Philadelphia (Conant, 1966; Böhlke, 1984:1,5; Smith-Vaniz and Peck, 1991). According to Hubbs (1964), the U.S. National Museum contracted with Fowler to study the *Albatross* Philippine fishes.

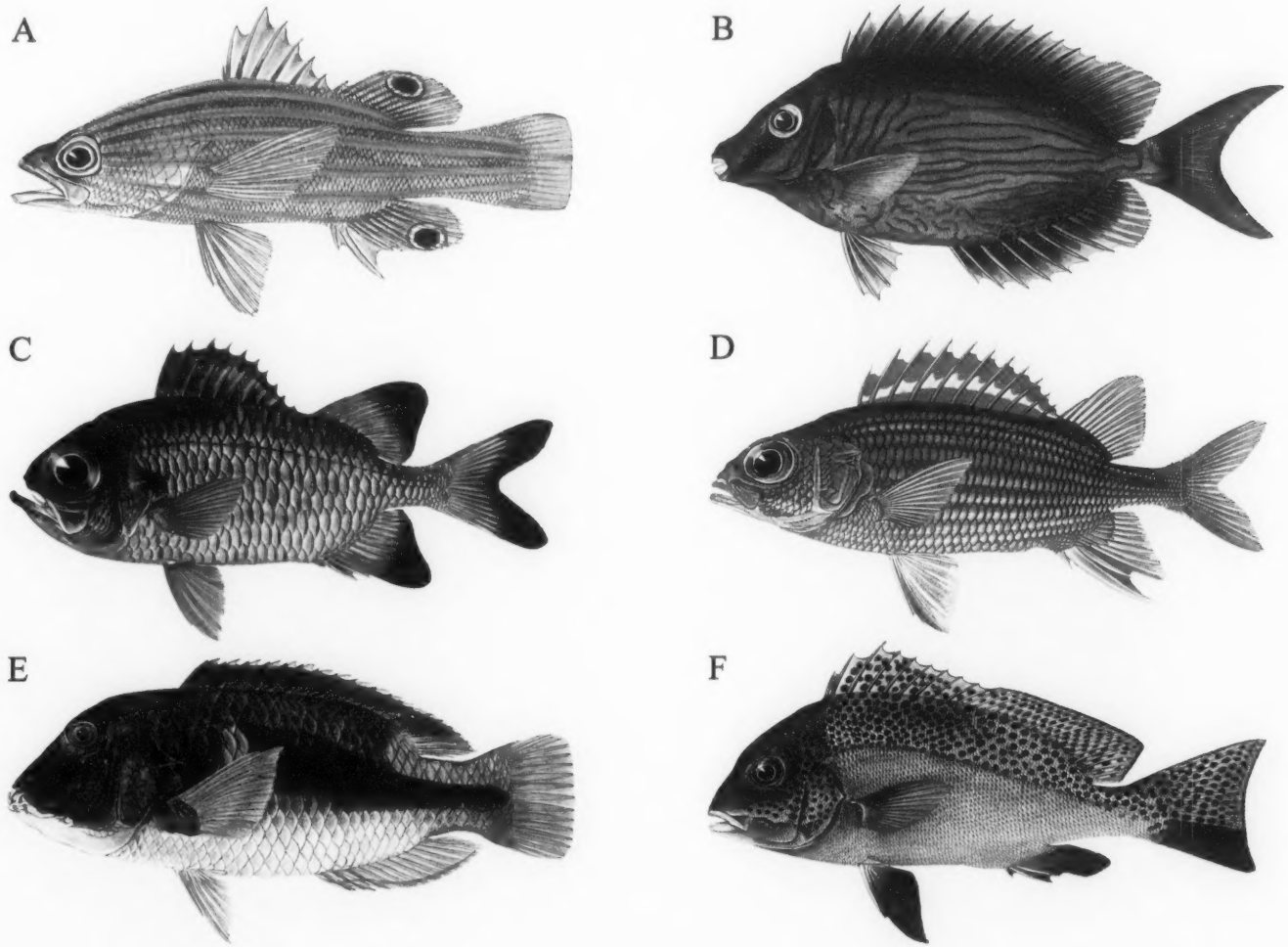

Plate 1.—Final color paintings made by Kumataro Ito of some fishes collected during the *Albatross* Philippine expedition. A, *Liopropoma swalesi* (attribution based on date of collection and style); B, *Siganus puellus* (attribution based on style); C, *Myripristis adustus* (sketch attributed toYasui in tin-tag register, no. 7389; final painting attributed to Ito based on style); D, *Sargocentron ittodai* (attribution based on date of collection and style); E, *Choerodon anchorago* (attribution based on style; preliminary sketch attributed to Ito in tin-tag register, no. 7480); F, *Plectorhinchus pictus* (attribution based on style; preliminary sketch attributed to Ito in tin-tag register, no. 7483).

out attribution to Ito. Ito's painting still represents our only knowledge of the fresh coloration of that species.

Whatever his eccentricities with regard to acknowledging illustrators, Hugh M. Smith never lost his high regard for Ito's work. In 1923, long after Smith had been elevated to Commissioner of Fisheries and the year after he left the Bureau of Fisheries, Smith, then beginning a 12-year tour in Thailand, requested Barton Bean, through an intermediary, to lend him one of Ito's colored illustrations of Philippine fishes. Bean noted on the letter of request that he furnished a painting of the snapper, *Lutjanus argentimaculatus*[42]. And I note here that the painting was never returned, and its whereabouts are unknown[43].

Ito Returns to Japan

After Ito returned to Japan from the United States, he continued to paint fishes and other marine organisms. He was the sole illustrator for a monumental two-volume Japanese work ("Illustrations of Japanese aquatic plants and animals") published by the Fisheries Society of Japan in 1931 (and reprinted in 1934). It contains more than 700 colored illustrations, but I think their quality is inferior to that of his *Albatross* paintings[44]. It can be inferred from the acknowledgment in the work that Ito was alive, and if the 1881 date mentioned earlier for his employment at the University of Tokyo is accurate, Ito probably would have been at least 70 years old at the time.

Other than Otaki et al. (1903–07) and the "Illustrations . . . ," just mentioned, the only other Japanese publication I know that refers to Ito by name, is a short article, which appeared only in Japanese, that I (Springer, 1985) wrote about him for the now defunct magazine *Anima*.

Smith never mounted his suggested public exhibition of Ito's Philippine fish paintings, but 48 of the paintings were among 200 original illustrations of fishes included in an exhibition I prepared entitled "Drawn from the Sea: Art in the Service of Ichthyology," which was displayed at the Smithsonian's Museum of Natural History from September to November 1985. Four (including the one illustrated herein as Color Plate 1C), all acknowledged, were included on the poster accompanying the exhibition. A subset of the illustrations, including many of Ito's, was sent on a 4-year tour to natural history museums in the United States and Canada under the auspices of the Smithsonian Institution Traveling Exhibition Service.

Ito's Philippine watercolor fish paintings are among the best produced by anyone up to his time. He made as many as three preliminary sketches before rendering the final painting, and the color is remarkably good. Had a treatise on the *Albatross* Philippine fishes been published reasonably promptly with Ito's colored illustrations, it would have stood as one of the greatest such publications up to that time, and many of the species would have appeared in color for the first time. Even today, some of Ito's paintings represent the only or best records of fresh color of several species (e.g. Color Plates 1A, 2B). A sampling of Ito's *Albatross* Philippine expedition paintings is contained in Color Plates 1–4.

When was Kumataro Ito born? How long did he live? What kind of person was he. What did he look like? These perplexing questions may well persist for as long as his magnificent paintings.[45, 46]

Addendum

Another Japanese Artist Aboard the *Albatross*

During Ito's second *Albatross* tour, another Japanese illustrator of fishes, Yasui, was also employed aboard the *Albatross*. How two artists came to be employed during a portion of the Philippine expedition is readily explained. Both Smith and Chamberlain were uncertain that Ito would participate in the expedition after the end of his first tour on 3 July 1908. Smith wrote Ito in Japan on 19 August 1908[23] inviting him to rejoin the *Albatross* in Hong Kong for a second Philippine tour. Chamberlain wrote Smith, 31 August 1908, after Ito's 3 July departure, requesting permission to employ a Japanese artist to replace Ito (inferred from Smith's response 6 October 1908[24]). Smith approved Chamberlain's request, but Ito accepted Smith's invitation, and so it eventuated that two artists, Ito and Yasui, were present during Ito's second *Albatross* Philippine tour. There is no information on how Chamberlain came to know Yasui, although, Ito may have recommended him.

I have not found Yasui's first name, and I have seen Yasui preceded by an initial, I, only once, on a preliminary color sketch (*Symphorichthys spilurus* Günther), for which a final rendering apparently was not made. Yasui's name does not appear in the *Albatross* ship logs nor in any correspondence, diaries, or publications that I have consulted. I have encountered Yasui's name only 7 times in the *Albatross* tin-tag specimen register (see below) and as faint, handwritten inscriptions (probably made by Chamberlain) on 3 final color renderings and about 10 preliminary color sketches of the fishes.

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[42] SIA RU 213, Division of Fishes, box 11, folder 4.

[43] In contrast, in March 1941, at least 32 years after he acquired them, Smith gave six original Ito paintings of goldfish, two of which had appeared as halftones in his book (Smith, 1909), and the 10 Urata paintings of goldfish, which Smith had also published in his book, to the Division of Fishes (SIA RU 213 Box 8, letter from J. E. Graf to H. M. Smith). All 16 originals are extant. One of the six Ito originals was published in color in *Smithsonian* magazine, September 1985, p. 185. Based on information I furnished, and in so far as then known to me, the illustration was attributed to an "anonymous artist."

[44] In his review of this work, C. L. Hubbs (1931:145) remarked, "The figures are reproduced from paintings by the famous fish artist Kumatarô Itô, which are remarkably true in drawing and coloring." Ito was probably well known to the Japanese and American ichthyologists of his time.

[45] All the color figures, except Plate 1A and Plate 3B, are reduced in size from the originals, by as much as one-half or more. Plate 1A and Plate 3B are enlarged approximately 20 and 10 percent, respectively.

[46] Although I spent considerable time searching the extensive records of the Bureau of Fisheries deposited in the U.S. National Archives, I may not have exhausted their holdings. Those files may contain additional information bearing on Ito's employment. Although copies of Hugh M. Smith's letters to Ito exist (all those I found are mentioned in my text), inexplicably, I found no copies of letters written by Ito, or for him, to Smith. Attempts by Japanese colleagues to locate information about Ito were unsuccessful, yet I believe there must have been Japanese fisheries publications earlier than that of Otaki et al. (1903–07) that contain Ito's illustrations.

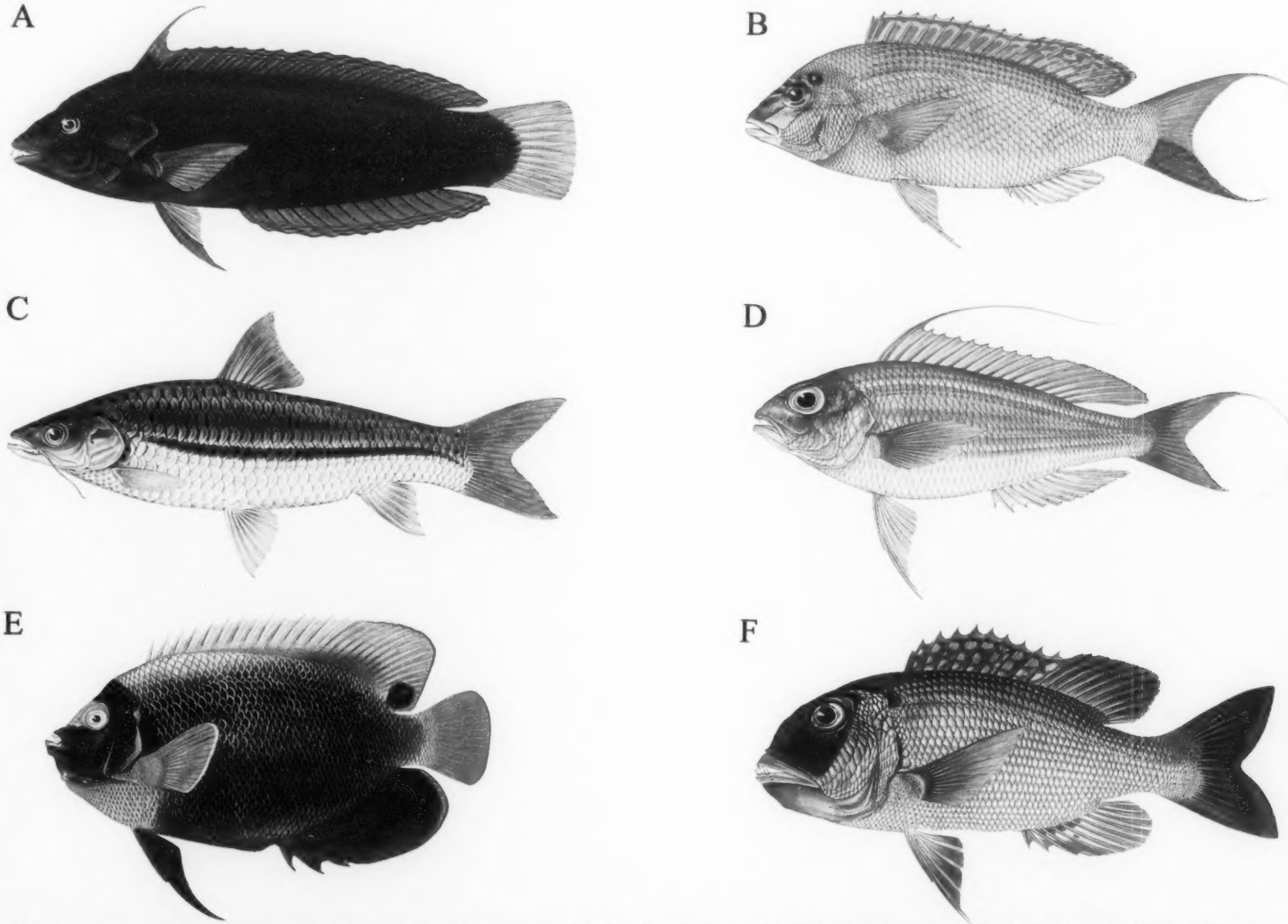

Plate 2.—Final color paintings made by Kumataro Ito of some fishes collected during the *Albatross* Philippine expedition. A, *Coris gaimard*, (attribution based on style); B, *Scolopsis temporalis* (attribution based on date of collection and style); C, *Leptobarbus melanotaenia* (attribution based on date of collection and style); D, *Nemipterus nematopterus* (attribution based on style); E, *Pomacanthus xanthometopon* (attribution based on style); F, *Monotaxis grandoculis* (attribution based on style).

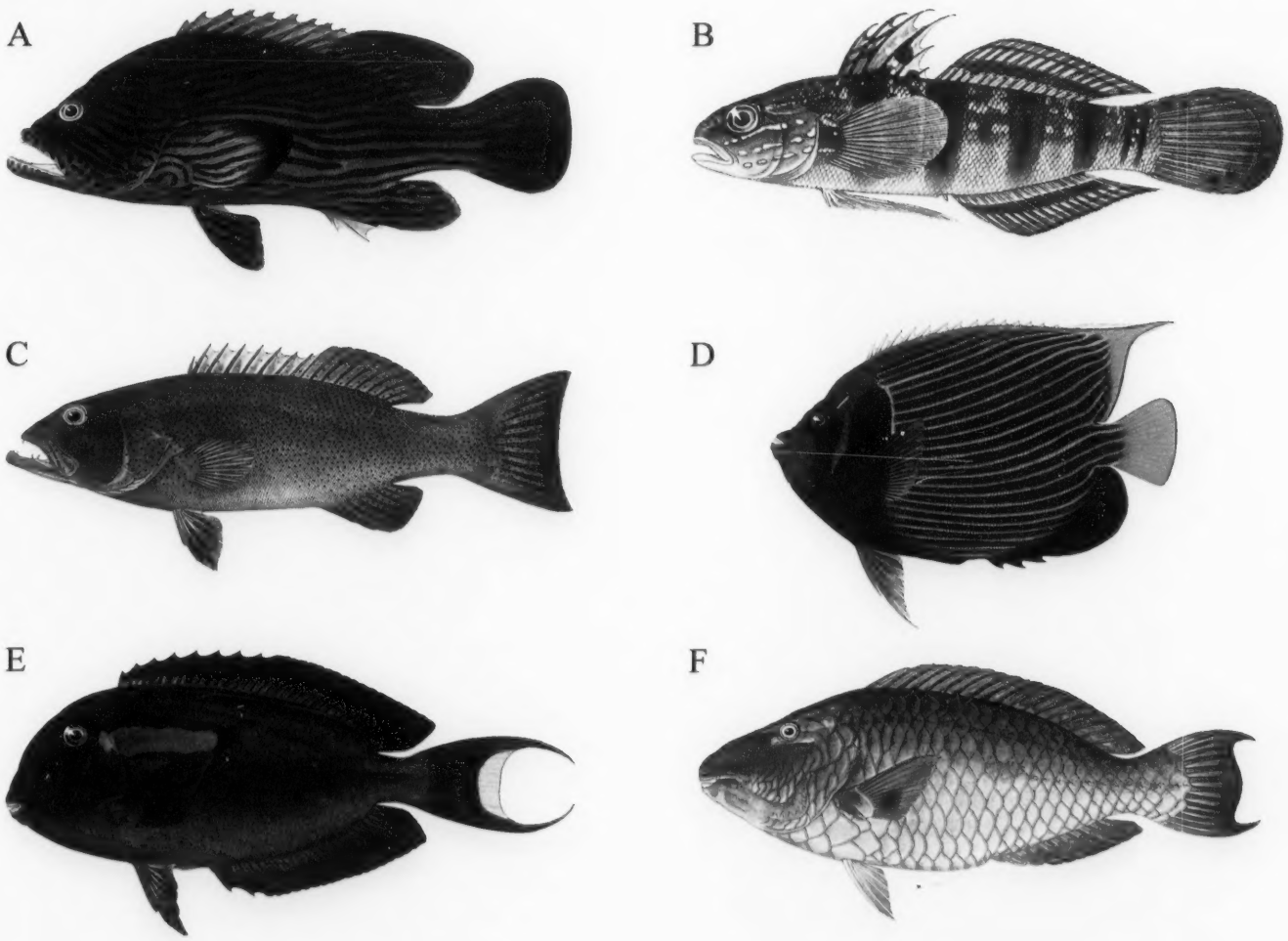

Plate 3.—Final color paintings made by Kumataro Ito of some fishes collected during the *Albatross* Philippine expedition. A, *Cephalopholis formosa* (attribution based on date of collection and style); B, *Amblygobius phalaena* (attribution based on style); C, *Plectropomus leopardus* (attribution based on date of collection and style); D, *Pomacanthus imperator* (attribution based on style; preliminary sketch attributed toYasui in tin-tag register, no. 8093); E, *Acanthurus olivaceous* (attribution based on style); F, *Hipposcarus longiceps* (attribution based on style).

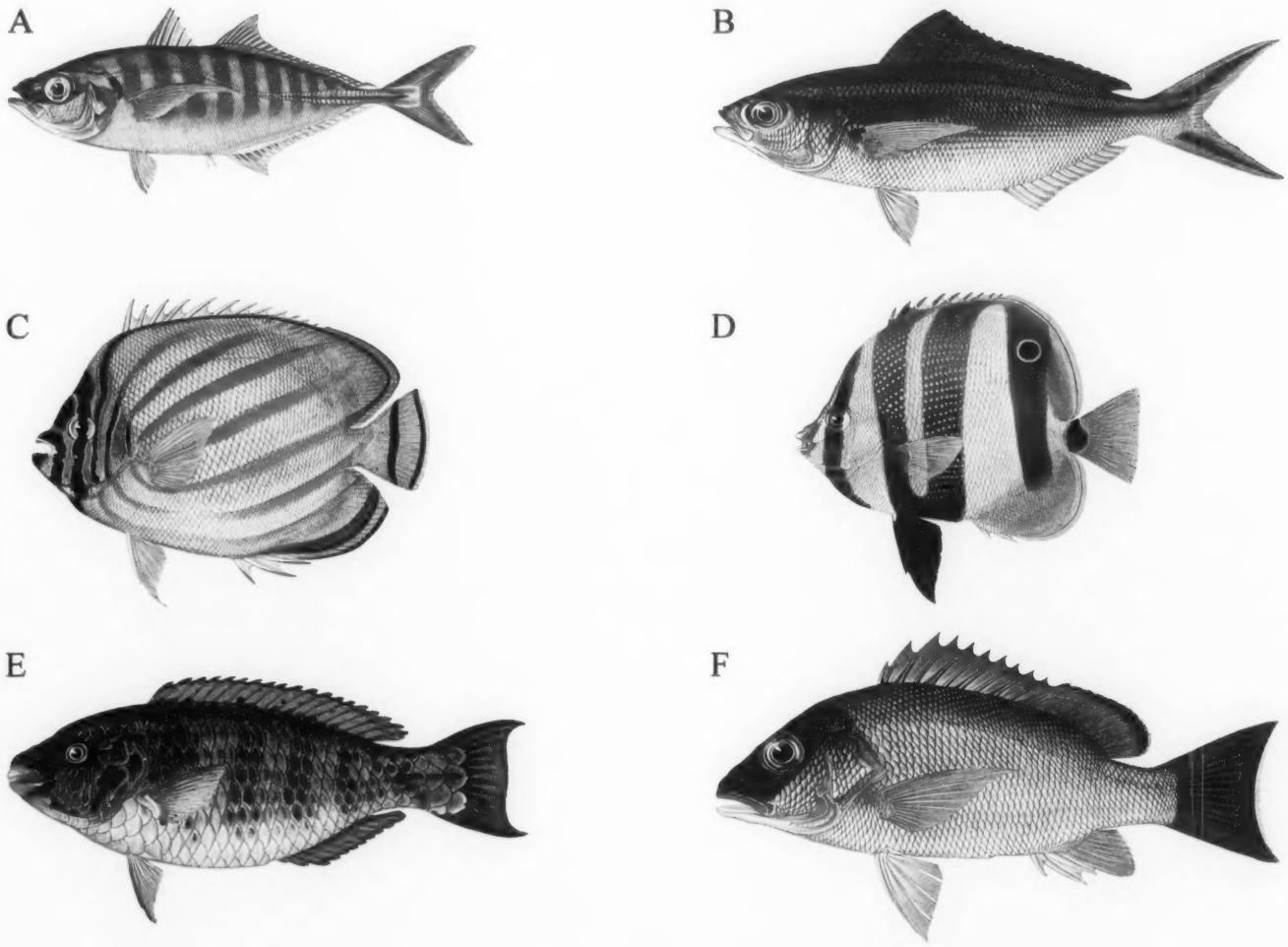

Plate 4.—Final color paintings made by Kumataro Ito of some fishes collected during the *Albatross* Philippine expedition. A, *Atule matta* (attribution based on style); B, *Caesio caerulaurea* (attribution based on style); C, *Chaetodon ornatissimus* (attribution based on style); D, *Coradion chrysozonus* (attribution based on date of collection and style); E, *Scarus ghobban* (attribution based on style); F, *Lutjanus fulvus* (attribution based on date of collection and style).

The *Albatross* Tag Registers

Many, if not almost all, of the fishes collected during the Philippine expedition were assigned a sequentially numbered tin or linen tag, often tied to the specimen. Each tag number was entered in a tin-tag or linen-tag register (originals filed in Division of Fishes, photocopies in Division and SI Archives) together with a variable amount of collecting data, but usually including the date and locality associated with the specimen. Infrequently (only 13 of over 22,000 assigned linen tags and 170 of about 5,200 assigned tin tags), a remark was added to an entry indicating the specimen was drawn. Although the total number of different specimens for which sketches and/or final renderings were made is unknown, it exceeds 183. Of the 183 drawn indications, 24 of the tin-tag entries, but none of the linen-tag entries, also indicate the name of the artist who prepared the drawing. Many preliminary sketches and final renderings of tagged fishes that were not indicated as drawn in the registers are present in the files, and several that were indicated only as drawn, bear the artist's name written somewhere, often faintly, on the artwork.

All of the drawn indications in the tag registers undoubtedly refer to preliminary color sketches made on the same day as the specimen was collected, although, doubtfully, some of these may also of have been rendered as final plates on that day. The artist had to sketch fresh specimens because the life colors of fish change or fade rapidly after death. Also, as many as six specimens collected on the same day (12 December 1907, tin-tag register), when only one artist, Ito, was on board, are noted as having been drawn, and it is doubtful that he could have done this many preliminaries and some final renderings on the same day. Finally, there are many preliminary color sketches for which there are no final renderings (n.b. preliminary sketches for many of the final renderings are missing).

Attribution of Paintings

By far, the largest number of the *Albatross* Philippine preliminary color sketches and final renderings carry no indication of the name of the artist responsible, but I believe that all but a very few of those not attributed were done by Ito. None of the specimens indicated as drawn in the tag registers during Ito's first and third tours aboard the *Albatross* (4 December 1907 to 3 July 1908; early ca. 27 September 1909 to early February 1910) indicate his name, but they can be attributed to Ito, as he was the only artist on board. Numerous sketches and final renderings are indicated on the artwork as having been based on two specimens, one collected during Ito's second tour and one collected during his third tour, and these can, therefore, be attributed to him.

Of the final renderings of specimens collected during Ito's first tour, Chamberlain's letter to Smith, dated 5 July 1908[19], mentions that he had all of Ito's preliminary sketches and a few of the final plates, all others having been sent to Smith. Not all the preliminary sketches were rendered as final plates during Ito's first tour, as I have found one plate based on a preliminary sketch (not present in files) done during this tour that is attributed to Yasui. This plate is unique in including a plain outline drawing as well as a color rendering (very little color is involved)[47]. Although collecting date and locality are entered on the plate, a pencilled annotation indicates the specimen was not tagged, and no drawn indications for the date are noted in the tag registers. Yasui's name, however, is lightly pencilled on the plate, followed by "(Ito's sketch)." Yasui must have produced the finished plate during the time of Ito's second tour with the *Albatross*, as this appears to be the only period when Yasui was present. The plate is the only final rendering I have seen that indicates preparation by Yasui based on an Ito sketch. Although I have not seen a written indication that Ito prepared a final rendering based on a Yasui sketch, I believe, based on the overall similarities of style of the finished paintings, that Ito is responsible for the final rendering of almost all of Yasui's sketches that were rendered.

Of the 24 tin-tagged specimens for which the register indicates the artist's name, 17 are attributed to Ito and 7 to Yasui. All of these attributions apply to specimens collected during Ito's second tour aboard the *Albatross*, the exact dates of which can only be inferred approximately. The first fish specimens indicated as having been drawn after Ito's first departure from the Philippines were collected 11 December 1908, shortly after the *Albatross* returned to Manila from Hong Kong, where it had undergone repairs from August to October. Between October and 11 December 1908, the *Albatross* was collecting in the vicinity of Hong Kong and the northern Philippines (Anonymous, 1910). It would seem that had an artist been on board during this period, he would have made some sketches, but I have found neither sketches nor final renderings that indicate they were made during the 11 October–11 December 1908 period[48].

The first specimen I have found that is indicated as drawn and attributed to an artist by name, Yasui, was collected 12 December 1908, and the first attributed to Ito, 22 December 1908. Based on this information, it appears probable that both Ito and Yasui joined the *Albatross* in Manila in December, even though Smith had suggested to Ito, at least, that he join the ship in Hong Kong (letter to Ito, 19 August 1908[23]).

During December 1908, the preliminary sketches in the tin-tag register

[47] The outline is based on a female deep-sea shark and the rendering is of one of its two small, excised embryos. H. M. Smith (1913b) designated the female as the holotype of a new genus and species, *Eridacnis radcliffei*. Smith did not publish Yasui's plate, but had black-and-white illustrations prepared of the holotype, which he did publish, and the embryo, which he did not. The black-and-white illustrations are not credited on the illustrations nor in the publication, but they were probably prepared by Ito during his work in Washington, D.C., in 1912, when he produced a large number of black-and-white drawings of deep-sea fishes for Smith and/or L. Radcliffe (discussed elsewhere in the text; also, see these authors in Literature Cited section).

[48] No fishes are indicated as drawn during Ito's first tour after 23 April 1908, which date closely coincides with the 28 April 1908 departure of H. M. Smith from the *Albatross*. It was probably during the period from April to July that Ito was involved in illustrating invertebrates for Paul Bartsch, as well as preparing final renderings of the preliminary color sketches.

are either unattributed or attributed to either Ito or Yasui. In January 1909, the sketches in the register are either unattributed or attributed only to Ito, but I have found 2 sketches, one of a snapper, *Lutjanus bohar*, dated 5 January, and the other a goby, dated 8 January 1909 that have Yasui's name pencilled on them. The final rendering of the snapper, which I will mention again, also has Yasui's name written on it; there is no final rendering of the goby sketch. From February to 23 June 1909, only one preliminary sketch is attributed to an artist, Yasui, on 5 March, in the tin-tag register. However, I have seen a sketch of a snapper, *L. lineolatus*, dated 11 March (and its final rendering) and 2 sketches of apogonids done on 4 and 5 April that are in the illustration files and bear Yasui's name, and two sketches (angelfish, parrotfish) dated 5 April with Ito's name inscribed on them. Although they possibly exist in the files, I am unaware of any color sketches or final color renderings of *Albatross* specimens collected after 5 April 1909 that are attributed to an artist by name.

According to a letter dated 4 August 1909[28] that Smith sent to Ito in Japan, Ito's second tour on the *Albatross* ended on 2 July 1909, a week after the last specimen was indicated as having been drawn. I think it probable that Yasui departed about the same time as Ito, if not sooner, and was not reemployed. In his letter, Smith also invited Ito to return to the *Albatross* about 1 October 1909 for a third tour. He also invited Ito to continue on the ship back to Japan and from there to San Francisco, so that Ito could save on the cost of his coming to Washington, D.C.. where Smith offered him continued work on rendering the sketches. There is no mention of Yasui or another artist being employed to do this work, and from later correspondence, it is clear that Smith had pinned all his hopes on Ito.

With two exceptions, 27 September 1909, and 2 October 1909 (*Leptobarbus melanotaenia*, a freshwater species, Plate 2C), no specimens are indicated as drawn after 23 June 1909 until 10 November 1909. The late September early October dates accord reasonably closely with Smith's estimate of the date when the last *Albatross* cruise would begin, and thus indicates the approximate date Ito returned to the Philippines. I know of no illustrations that were made between 2 October and 10 November 1909. From 10 November 1909 to 29 January 1910, on which date the *Albatross* departed Formosa (= Taiwan), numerous unattributed sketches are indicated in the tin-tag register. Ito apparently left the ship in Japan, as Smith's correspondence after the expedition ended continued to implore Ito to come to Washington, D.C.

The question arises as to how to distinguish Ito's work from Yasui's during the second tour. From having examined the illustrations closely, and particularly the final renderings, I was impressed by the great similarity of technique and line of all but a very few. Those that were dissimilar were either unattributed or attributed to Yasui. From a comparison of final renderings actually attributed to one or the other of these two artists, I found Yasui's final renderings (and most of his sketches) much inferior to those of Ito's. With the exception of the uncomplicated rendering of Ito's sketch of the shark mentioned earlier, my appraisal of the few Yasui-attributed final renderings, is that they are unacceptable. Fine lines used to outline the margin of the fish, particularly along the body ventrally, are weak and sometimes broken; the color is often less than sharply applied, with smudgings that can best be seen with slight enlargement. The final rendering of the snapper identified as *Lutjanus bohar*, I consider sloppy. Another, unattributed, final rendering identified as the same species, but clearly based on a different specimen and by a different artist is sharp and beautiful, and consistent with the style of finals attributable to Ito based on date. The preliminary sketch of another snapper, identified as *Lutjanus lineolatus* and attributed to Yasui, has "very poor" inscribed on it, presumably by Chamberlain, and I would say the same of the final rendering, which also bears Yasui's name and has "color?" written on it. Although many of the sketches and finals I attribute to Ito bear criticisms, I have seen none indicated as "poor." Finally, a very poor preliminary sketch of *Holacanthus imperator* (= *Pomacanthus imperator*), which is attributed to Yasui, has "checked up by Ito" written on it, and I believe that Ito did the final rendering (Color plate 3D).

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Agassiz, Garman, *Albatross*, and the Collection of Deep-sea Fishes

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Introduction

The U.S. Fish Commission Steamer *Albatross* was sent forth on many, often pioneering, missions of basic and applied science. Principally, this ship was engaged in defining and discovering new fishing grounds and exploitable species. The impact of these expeditions on the development of various fisheries is evident in several of the papers in this special issue of the *Marine Fisheries Review*. However, the long-term legacy, and indeed the immortality of the *Albatross* rests to a great extent on the purely scientific findings that arose from both the applied ventures and the few voyages which were entirely devoted to oceanography and organismic biology.

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ABSTRACT—The first of Alexander Agassiz' voyages on the U.S. Fish Commission steamer Albatross *in 1891 yielded significant scientific results. This paper reviews the background of the voyage, including the career path that led Agassiz to the back deck of the* Albatross. *We also give a brief account of the life and work of Samuel Garman. Garman wrote up the ichthyological material from this* Albatross *voyage in a magnificent book on deep-sea fishes published in 1899. This book was exceptional in its coverage, anatomical detail, and recognition of phylogenetically important morphology.*

Among these expeditions was a rare trip, under nongovernment funding, from which the specimens were deposited and described at the Museum of Comparative Zoology (MCZ) at Harvard University. This particular voyage left an impressive legacy due primarily to the disparate talents of two participants—the noted invertebrate embryologist Alexander Agassiz and the irascible ichthyologist Samuel Garman.

We are concerned with a single voyage, in 1891, of only 2 months duration, during which the *Albatross* conducted deep-water trawls and sampled the eastern Pacific off Panama and Ecuador. Alexander Agassiz (Fig. 1), the director of the Museum of Comparative Zoology, was in charge of the expedition. He also funded the running costs and provided part of the scientific party. The collections from this expedition were worked up over the years by many authorities, both at the MCZ and at other institutions, but perhaps one of the finest scientific legacies is the volume of deep-sea fishes authored by Samuel Garman (1899) (Fig. 2).

This voyage was the outcome of the persistence and drive that characterized Alexander Agassiz (Agassiz, 1913). Born in Switzerland in 1835 to the impecunious but brilliant zoologist Louis Agassiz, Alexander was destined to become a biologist. During Alexander's early childhood, his father parlayed a prestigious speaking engagement in the United States into the founding of the Museum of Comparative Zoology. Thus, young Alexander was immersed both in the science of that museum and its precarious finances from a very young age. He graduated from Harvard in 1855, and was awarded two baccalaureate degrees, the first in 1857 and the second in 1862 from the Lawrence Scientific School (his father's domain), where he studied zoology, geology, chemistry, and engineering. His father then convinced him to sign on as an assistant in the Museum, despite the fact that he wanted to become a railroad engineer, and he took charge of the work and business of the institution (Agassiz, 1913).

Determined not to follow in his father's footsteps in all ways, in 1868 the young Agassiz decided to accept an offer from his brother-in-law, Quincy Shaw, to assume managerial control over the failing Calumet and Hecla copper mines in Michigan. According to Eliot (1910), this decision was based on his desire to make money, because he considered that a successful career as a naturalist in the United States required independent personal funds. As it turned out this decision was to prove especially appropriate for Alexander. His opinion was no doubt largely due to the financial difficulties, both institutional and personal, into which his father continually plunged the MCZ as well as his family.

Though Alexander Agassiz had many setbacks, the Calumet and Hecla copper mining companies in Michigan were eventually able to supply his personal needs as well as those of the museum. Moreover, it was entirely due to his personal fortune, accrued by his skill in managing the copper mines, that subsequently enabled him to undertake his remarkable 30 years of worldwide oceanographic explorations (Zinn, 1980).

In 1873 Louis Agassiz died and the directorship of the MCZ passed to Alexander, a position he held actively until 1904. Under doctor's orders to stay away from the Cambridge winters, Agassiz began a series of winter field trips. The first was to Lake Titicaca,

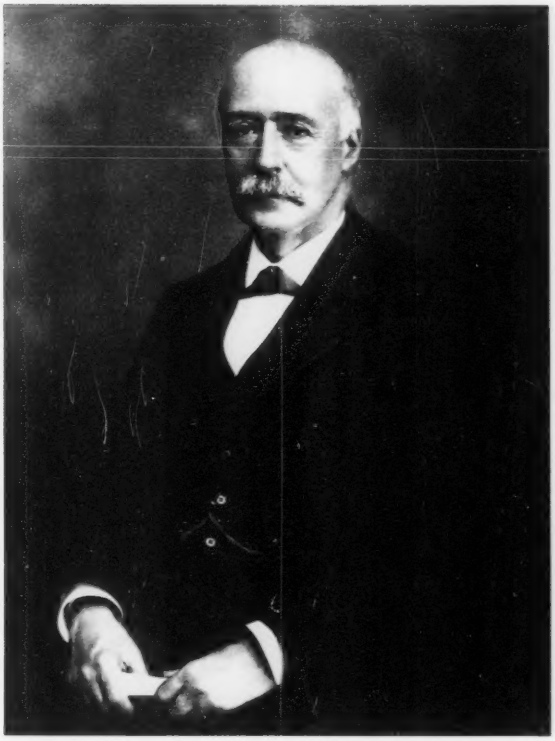

Figure 1.—Alexander Agassiz (1835–1910), director of the Museum of Comparative Zoology and chief zoologist in charge of the collecting expedition of the *Albatross* in the winter of 1891. Reproduced with permission of the MCZ archives.

Figure 2.—A middle-aged Samuel Garman (1843–1927), western explorer turned curator of fishes, amphibians, and reptiles at the Museum of Comparative Zoology. Reproduced with permission of the MCZ archives.

between Bolivia and Peru, where he prospected in a hired steamer. Later explorations of the Caribbean were made from J. H. Forbes yacht, the *Wild Duck*, and the U.S. Coastal Survey Steamer *Blake*.

During three cruises from 1877 to 1880 Alexander used the *Blake* to gather zoological evidence for his theories of biogeography and oceanography (Agassiz, 1888). His passion was echinoderms, with many of his publications detailing the variation within and among species of sea urchins. With typical European feeling for his patrimony, Agassiz also devoted considerable time and expense to ichthyology, the field in which his father had made such important contributions. He often took his father's last student, Samuel Garman, on voyages to work up the fish collections.

Pacific Interest

With an already extensive knowledge of the Atlantic and Caribbean fauna, Agassiz was extremely interested in collections from the Pacific. On several occasions he inquired about the possibility of using the *Albatross* to do a survey of the eastern Pacific's deep waters. He was particularly interested in two questions: 1) is there life in the intermediate depths, and 2) is the fauna of the Pacific in any way related to the creatures he collected from the Caribbean abyss?

Finally, in 1890, when Agassiz was 55 years old, Colonel Marshall MacDonald, Commissioner of the U.S. Fish Commission, asked him to take charge of a deep-sea survey with the *Albatross* (Fig. 3). The conditions of this voyage were quite similar to those of the *Blake*; Agassiz would pay for coal and assist in equipping the boat in return for the first series of specimens. Many of the techniques for sampling the abyssal depths had been designed, tested, and refined on the *Blake* by Count Louis François de Portalès, including the "Blake trawl," and this outfitting was important for the success of the collecting trip (Agassiz, 1888). Moreover, the captain of the *Albatross*, Zera L. Tanner, had designed and fabricated a variety of ingenious nets (the designs of some are still used today) to sample the pelagic fauna (Fig. 4). The trip was certainly quite expensive for Agassiz: he spent $12,000 on coal alone, which would be over $180,000 today. Agassiz clearly felt that the information to be gained from this field trip was extremely important.

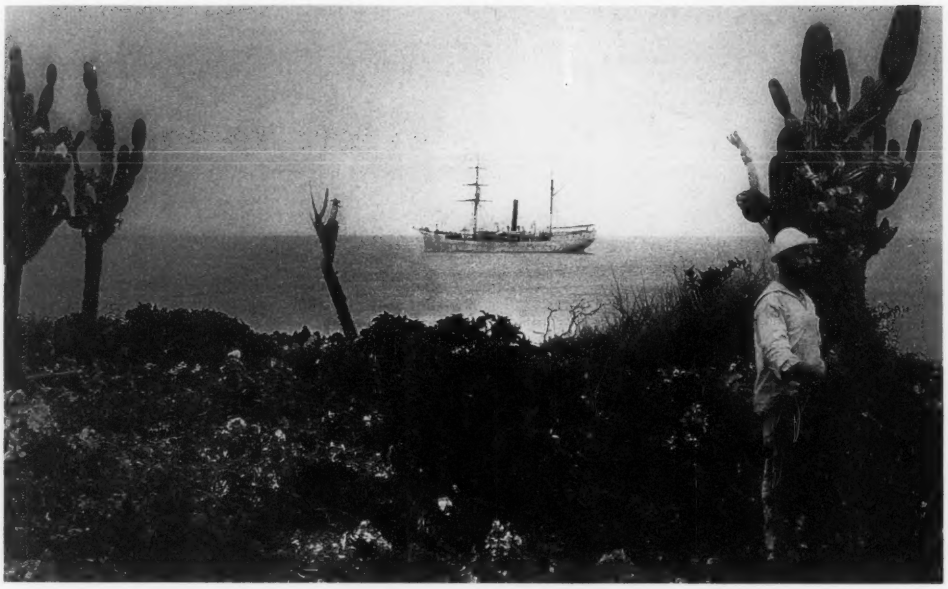

Figure 3.—The *Albatross* seen from the Galapagos Islands during the 1891 voyage. Reproduced with permission of the MCZ archives.

Agassiz' (1892) general sketch of the expedition, published soon after his return from the voyage, discusses in depth the intermediate fauna. The question, simply put, sought the bathymetrical range of the pelagic fauna: "Having always been more or less interested in pelagic fauna, having paid considerable attention to its vertical distribution during my earlier cruises on the *Blake*, I was naturally anxious to reconcile the conflicting statements and expressions of the naturalists of the *Challenger* and *Gazelle* on one side, and my own observations on the other" (Agassiz, 1892). Agassiz argued that the nets used for collection in earlier attempts to study the midwater fauna, (including those of John Murray during the *Challenger* cruises, the Prince of Monaco off the yacht *Hirondelle*, Carl Chun in the deep waters around the Canary Islands, and Hensen during the expedition of the *National*) were questionable because the depth at which the animals were netted could not be accurately determined. He hoped that with the use of Tanner's newly designed closing net, he would finally put the questions to rest.

The tows with this net were not entirely successful during the 1891 *Albatross* expedition. They did establish the presence of the pelagic fauna down to 300 fathoms, but the mid waters below this depth appeared to Agassiz to be devoid of plankton. Unfortunately, the waters he sampled during both the *Blake* expeditions and the 1891 *Albatross* expedition were not representative of intermediate oceanic depths. We now know that these regions are plankton-poor because of certain oceanographic features. So Agassiz eventually failed in the first of his objectives in boarding the *Albatross* in 1891, but only because of an unfortunate combination of circumstances. A superb treatment of this phase of Agassiz' career is given by Mills (1980).

Alexander Agassiz made three more voyages on the *Albatross*, extending his surveys into the middle and western Pacific. Voyages after 1891 primarily used dredges, plankton nets, and coring drills rather than fish-sampling gear. His main goal on these trips was to prove his theory of coral reef formation. The competing theory, of Charles Darwin (1874), ultimately prevailed, and much of the theoretical underpinning of Alexander Agassiz' biology now has little application. In contrast, the descriptions of the fishes collected on his first *Albatross* voyage remain an important part of the ichthyological literature. This is largely due to the efforts of Samuel Walton Garman and the two artists whom he supervised.

Samuel Garman

Garman remains one of the most colorful and enigmatic figures in ichthyology. He was born in Pennsylvania of Quaker parents in 1843. He attended the Normal College in Illinois and participated in an early expedition to explore the west. On this trip, in 1868, under the direction of Major John Wesley Powell, he traveled through Colorado and Wyoming. He was briefly a field assistant for Edward Drinker Cope in 1872, and he certainly knew the western fossil localities reasonably well. It was perhaps this knowledge that eventually earned him a place at the Museum of Comparative Zoology.

In 1870 Louis Agassiz was returning from the *Hassler* expedition, a cir-

cumnavigation of South America. At the final destination, San Francisco, he met Garman and was so impressed with him that he asked him to return to Cambridge and immediately take up a position at the museum. For many years the elder Agassiz had been hoping to get a good paleontologist at the museum. He had pursued Othneil C. Marsh but failed to lure the emerging fossil expert away from Yale, and he had even considered going on collecting expeditions himself (Agassiz, 1886; Lurie, 1988). So, it is likely that Garman's field experience in the western fossil fields appealed to Louis Agassiz, especially given the paucity of North American fossils in the MCZ. Garman did in fact make several trips to collect fossils in the Dakotas and Wyoming in the 1880's under the aegis of the MCZ (Summers and Koob, 1997).

Garman settled into the MCZ fish department and was immediately drawn to the cartilaginous fishes, an interest that lasted his entire life. He assisted Agassiz at the short-lived "Lawrence School," a summer school for teachers of natural history on Penikese Island, Mass., and later became a jack-of-all-trades around the museum. Just 18 months after Garman arrived at the MCZ, Louis Agassiz died, but fortunately Alexander Agassiz was determined that his father's work continue. This meant several field trips for Garman to the American west as well as to Peru and the Caribbean. He demonstrated his zoological skills on the trips and in the publications that ensued from them (Garman, 1875; 1881). His duties embraced all aspects of museum work, including preparator, exhibit designer, collector, collections manager, curator, and public spokesman. The press of these duties kept him from participating in any of the field collections after 1888, though there was a commensurate upturn in his output of papers (Summers, 1997).

Garman stayed at the museum during the *Albatross* expeditions to look after the collections and continue his writing. This was not a particular hardship since the fishes collected would be brought back to him eventually; also, Andreas Westergren, an MCZ artist, was on the trip to record colors from life (Fig. 5). It took 7 years to complete the *Albatross* fishes, and in 1899 the volume was finally published (Garman, 1899). After this, Garman seems to have become more reclusive. He was much affected by the alleged subterfuge, political infighting, and eventual adverse publicity attached to the so called "dinosaur wars" between E. D. Cope and O. C. Marsh (Plate, 1964, provides details on the controversy). He became increasingly private about his work, even going so far as to cover work in progress with newspapers when the rare vis-

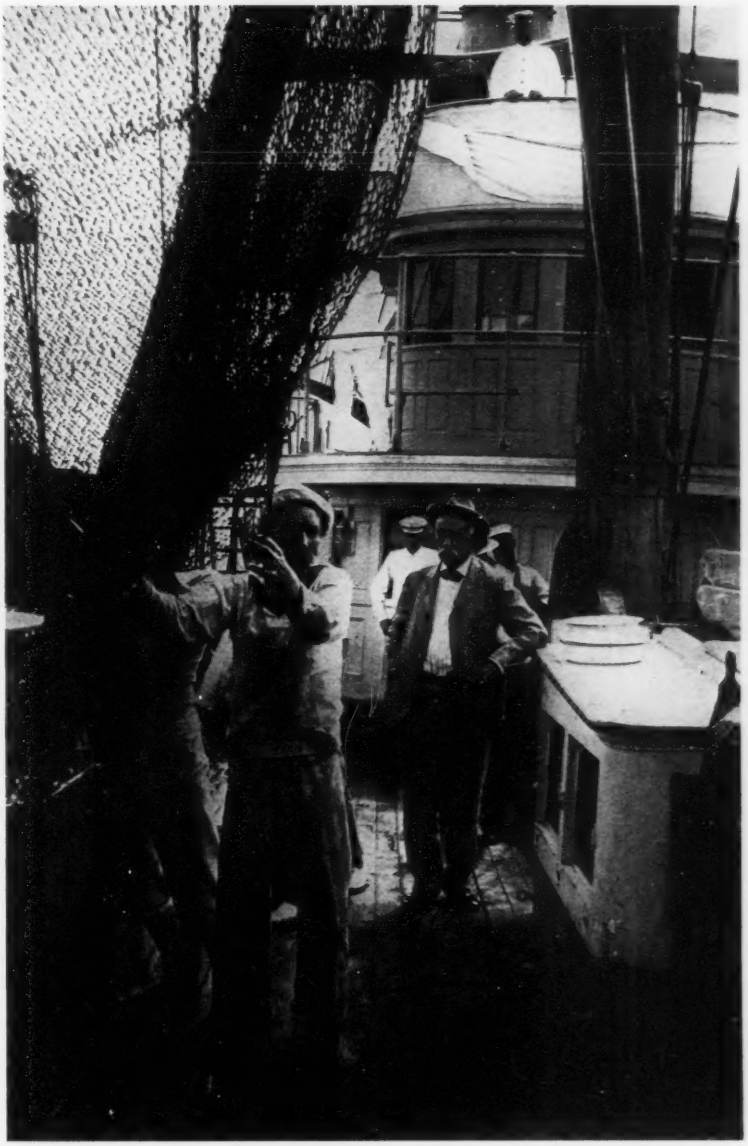

Figure 4.—The back deck of the *Albatross* just after a trawl has been emptied. The well-dressed man is Alexander Agassiz. Several of the crew, in naval whites, are looking on. Reproduced with permission of the MCZ archives.

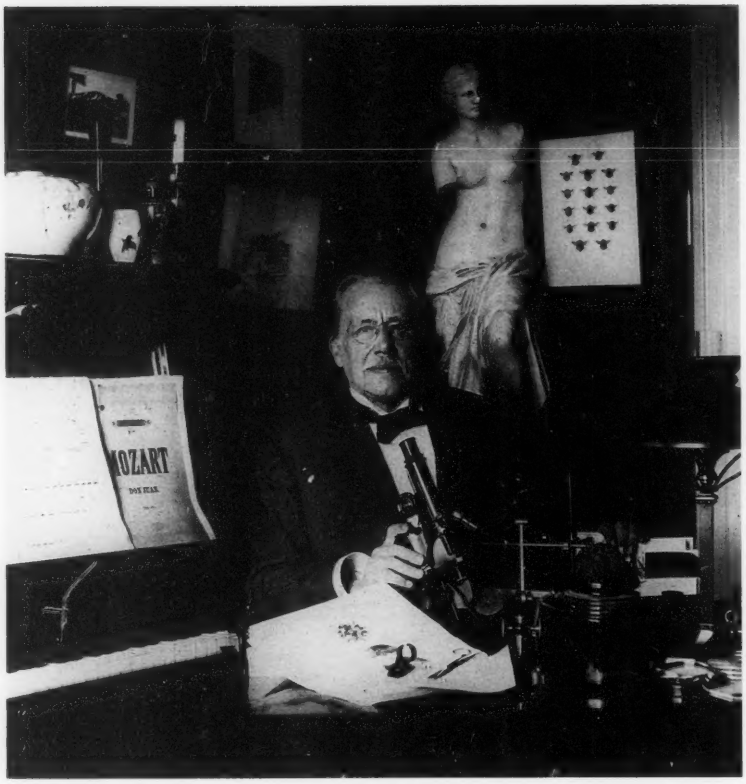

Figure 5.—Andreas Magnus Westergren (1844–?) was one of two principal artists for the deep-sea fishes book (Garman, 1899). He recorded the colors of animals fresh from the deep.

itor arrived and was grudgingly admitted to his office in the fish department.

It was this Garman that the young Thomas Barbour knew when the latter started working in the MCZ herpetology collection. This antisocial tendency worsened with age. After eventually succeeding to the directorship of the museum, Barbour lampooned the unfortunate Garman in his various memoirs (Barbour, 1943; 1946). Though Garman continued to work at the museum until his death at age 84, he was not productive after 1913 when his monumental monograph on the cartilaginous fishes appeared (Garman, 1913).

The 1891 Expedition

Agassiz, Westergren, and the rest of the MCZ party arrived in Panama at the end of February 1891. They boarded the ship for the first leg of the voyage, which took them out into Panama Bay, to the Cocos Islands, and back. The second leg of the trip went to the Galapagos Islands and then back to the mainland at Acapulco, Mex., and the third and final leg ended in Guaymas, Mex., in the Gulf of California where they boarded a train back to Boston (Fig. 6).

This voyage was exceptional in that it concentrated on an investigation of the relatively unexplored deep sea. In total, 75 trawl hauls were made, of which more than half were at depths greater than 1,000 m and a quarter were below 2,000 m. Previous *Albatross* collections in the Pacific between Chile and Alaska fished below 1,000 m only 3% of the time. This is hardly surprising since the fishes at these great depths would have been difficult to exploit commercially. The collection work was supervised by Alexander Agassiz, with the help of Charles Townsend, whom Agassiz called "the most obliging and hard-working man imaginable" (Agassiz, 1913). Townsend would later become director of the Aquarium of the New York Zoological Society, and he also published extensively on natural history.

In 1891 *Albatross* specimens were preserved in several washes of ethanol and then wrapped in gauze. This expedition just predates the wide use of formalin, which is a mixed blessing. Many of the specimens are now so soft and friable that they are not very useful for anatomical work. However, ethanol preservation does not irreparably destroy DNA, so this material may prove quite useful for future studies. It is not well known in the molecular biological community that many early, extensive faunal collections have never been fixed in formalin and thus represent an untapped source of historical DNA.

When the specimens were returned to the MCZ, the real work began. Working from color sketches made on the deck, Andreas Magnus Westergren produced 20 color plates for the deep-sea fishes volume (Garman, 1899) (Fig. 7). It is interesting to note that many of these plates are of brown or very dark fish, with just a flash of bright color, bioluminescence, or reflective material. Westergren and John Henry Blake, both born in 1844, shared the illustration duties. Both were gifted illustrators with many other works to their credit. Westergren worked on crinoid and echinoid plates for Alexander Agassiz (1892; 1906; 1908), as well as Faxon's famous work on stalk-eyed crustaceans (Faxon, 1914). He specialized in color work, but, as evidenced in the deep-sea fishes book, he was adept in monochrome as well.

Henry Blake started illustrating works for the MCZ in 1866 at age 22 and became the favored illustrator of Garman (i.e. Garman, 1904). His work can often be distinguished from that of Westergren by artistic touches such as the symmetrical curves in the eels in plates 41 and 43 (Fig. 8). Blake remained at the MCZ for many years after the deep-sea

fishes (Garman, 1899) was published and was the artist for Garman's Plagiostomia (1913).

One of the most revolutionary aspects of these illustrations is the amount of anatomical detail. The usual illustrations of external anatomy are accompanied by wonderful renditions of internal detail, the result of Garman's extraordinary dissecting ability. These anatomical drawings include skeletal elements and soft anatomy. This is marked contrast to the far better known work "Oceanic Ichthyology" by George Brown Goode and Tarleton Bean (1895). Of the 123 plates in Goode and Bean (1895), there is but a single skeleton, that of an anglerfish (plate CXX). In general, Garman's anatomical illustrations reflect his careful and skilled dissection of the anatomical details that have proved to be important distinguishing features of the taxa (Fig. 9); however, in some cases the artistic license of the illustrator actually serves to detract from the usefulness of the drawings. For example the gill arch structures of the roughy in plate XI (Fig. 10) have a lovely, sweeping line that fails to show where the finer elements are joined.

The text of the deep-sea fishes book (Garman, 1899) is in five parts. The first part describes the collection of the specimens and also contains Garman's musings on speciation, divergence, and general morphology of deep-sea forms. The second section consists of descriptions of the fishes, which are often in themselves far too brief to be particularly useful today. In many cases there is little attempt to compare species, and instead each is described as if the others do not exist. Part of the difficulty is that there was little comparative material at the museum. Garman did borrow some specimens from the U.S. National Museum, but for the most part he relied on the collection at hand. Were it not for the excellent detail of the plates, these descriptions would be far less valuable.

The third section of the book deals with the variation in the lateral line system of deep-sea fishes. Garman dissected, traced, and described the lateralis enervation, no mean feat in the days before nerve stains and tissue clearing.

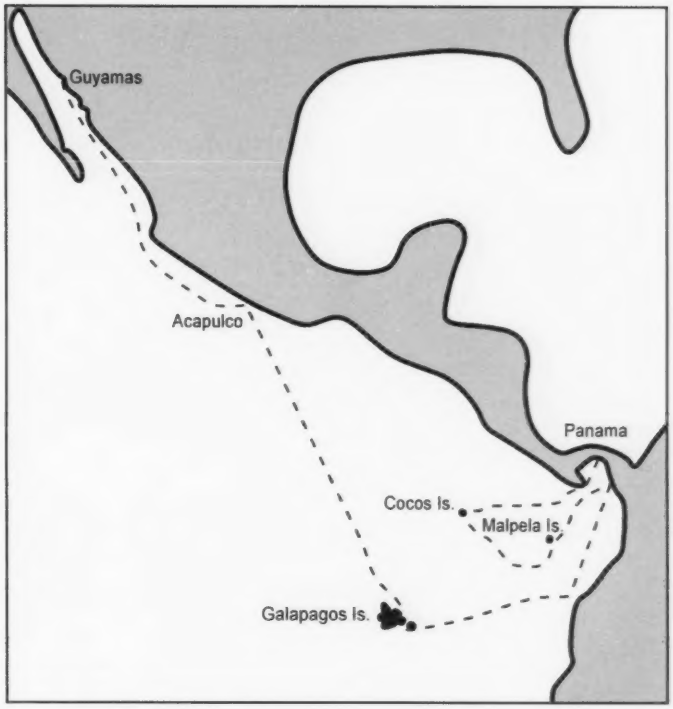

Figure 6.—The 1891 voyage of the *Albatross*.

He also prepared diagrammatic representations of the lateral line canals of 27 species. This is one of the very early works on the anatomy of the lateral line system and one of the most extensive examinations of the differences in morphology across taxa. He even makes some speculative comments about the arrangement of "glandular disks" (free neuromasts) and lateral line canals in fishes with reduced eyes living in low-light environments.

The fourth section of the book addresses one of Agassiz' prime questions in organizing the trip: the relationship between fauna on either side of the Panamanian isthmus. In comparing the fauna from the *Blake* expeditions to that of the *Albatross*, Garman concluded that the uniform environment of the abyssal depths makes it easy for fish to move around the capes of the southern ocean, and so they are not the best organisms to examine for evidence of a Central American connection. His conclusion about the relations of the fish fauna contrasts with Agassiz' initial conclusion based on the echini that "the Caribbean was probably a bay of the Pacific" (Agassiz, 1892). However, Garman went on to list 42 taxa that might provide evidence of the existence of a channel. The final section of the book gives evidence of Garman's bibliographic skills and interests. He lists 1,047 species of fishes, all of the deep-sea fishes for which he could find references.

Garman treated 196 taxa of deep-sea fishes in the *Albatross* report. He described and figured 174 new species, of which about 80% are valid today. Most of the species that he dealt with are benthic, bathypelagic, or mesopelagic, and many of the species are still represented by only the type series. He described 20 species of ophidiiformes, or deep-sea cusk-eels, of which 17 are still considered valid. Of the 13 zoarcids, or eel-pouts, 11 were described as new and nine remain valid. Nine of the 12 ogcocephalids, or batfishes, are still considered valid species, and there

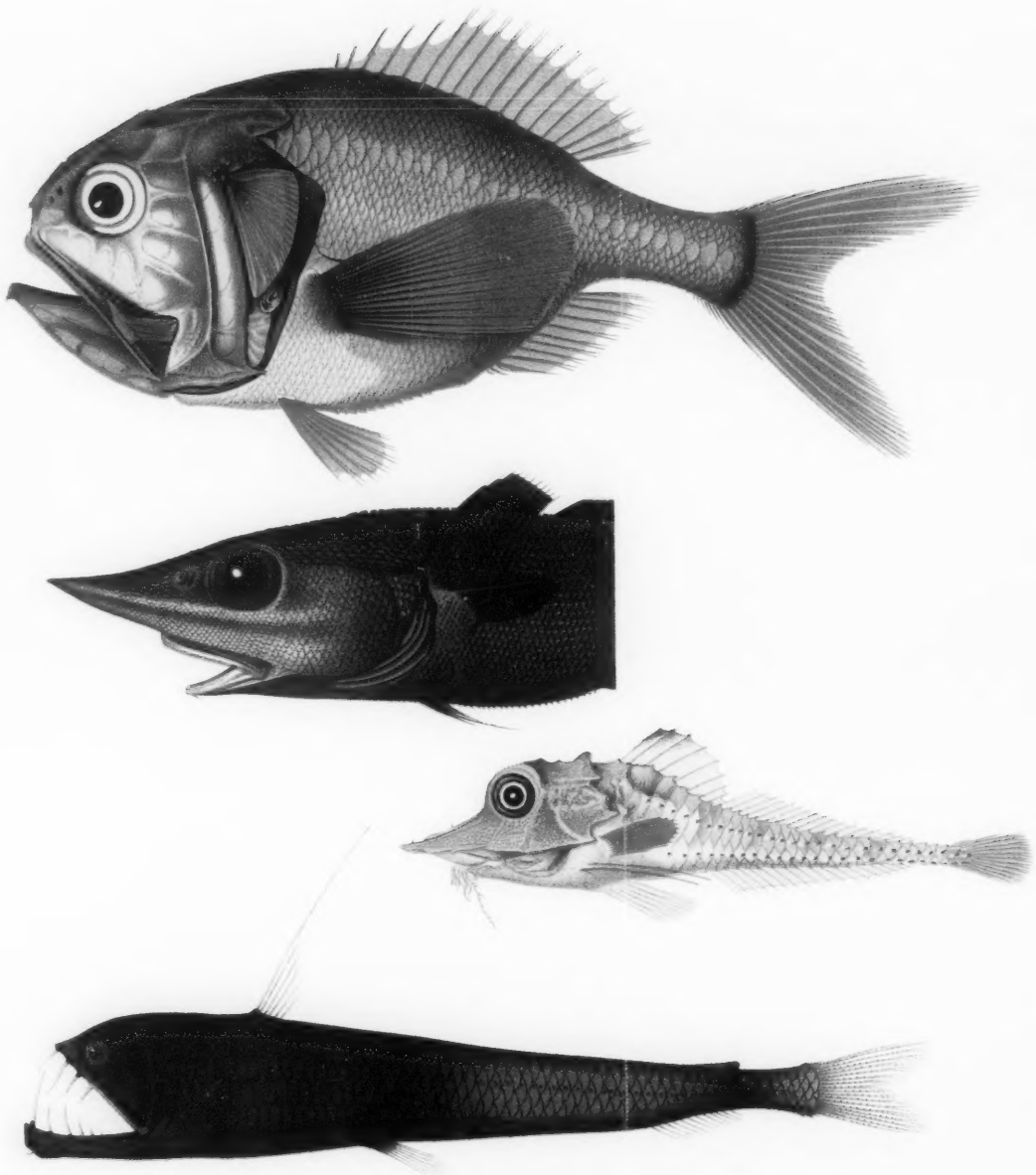

Figure 7.—Illustrations of fishes in color. From top to bottom: a roughy, *Hoplostethus pacificus* Garman (Trachichthyidae), a deep-water beryciform. A macrourid, *Trachyrhynchus helolepis* (Gilbert). An armored searobin, *Peristedion crustosum* Garman, a triglid in the family Peristediidae (armored gurnards). A viperfish, *Chauliodus barbatus* Garman, a stomiid in the family Stomiidae (viperfish). Drawn by A. M. Westergren (from Garman, 1899).

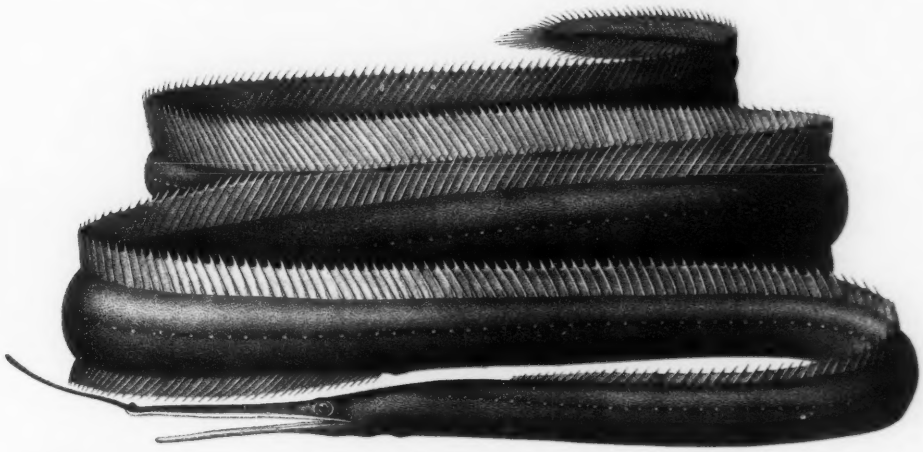

Figure 8.—This pike-conger shows J. H. Blake's fine artistic style. The fish is *Venefica ocella* Garman, a nettastomatid eel, one of 25 new species described by Garman in his deep-sea fishes book (Garman, 1899:pl. LXI).

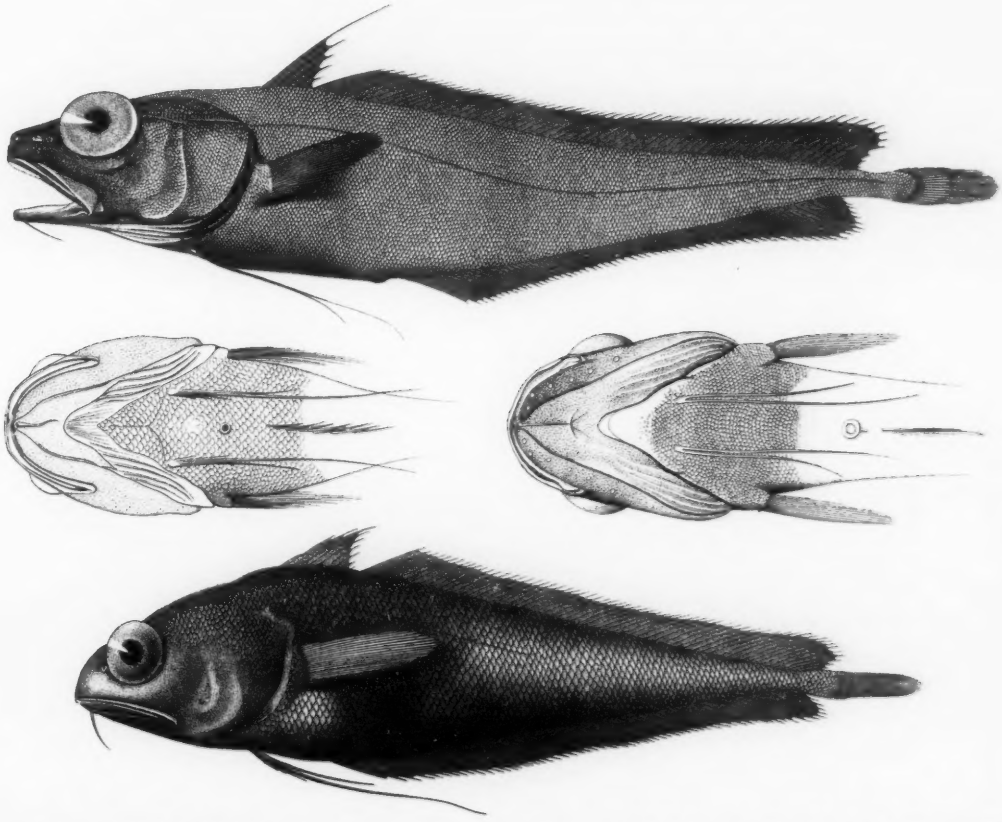

Figure 9.—Morid codfish (Moridae): Top, *Laemonema gracillipes* Garman; middle left, underside of the head of *L. gracillipes*; middle right, underside of the head of *Physiculus nematopus*; bottom, *Physiculus nematopus* Gilbert. Drawn by A. M. Westergren (from Garman, 1899: pl. XLII).

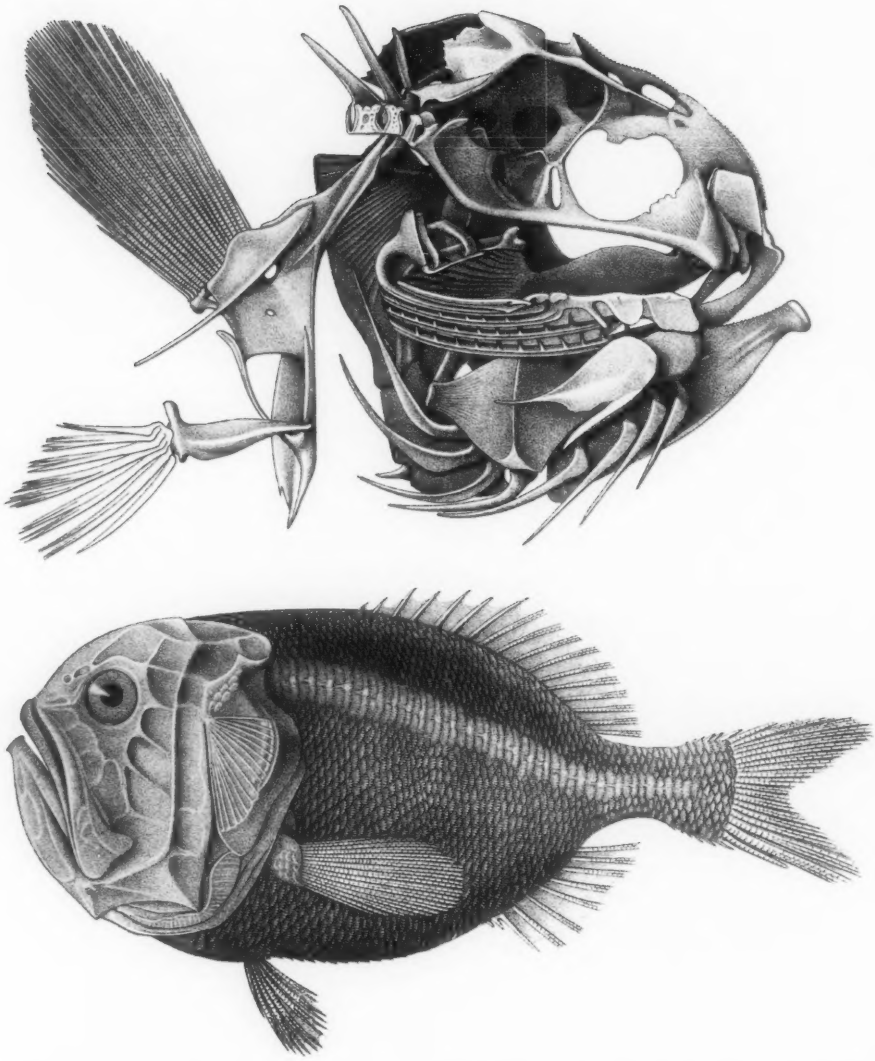

Figure 10.—Internal and external anatomy of the roughy. Top, the skeleton of *Hoplostethus pacificus* (Trachichthyidae). Though the skeleton is well rendered in most respects, the detail of the neurocranium and branchial arches is glossed over. The external anatomy of this fish is seen in Figure 7. Bottom, *Hoplostethus mento* (Garman), another roughy which Garman has assigned to the genus *Trachichthyes*. Drawn by A. M. Westergren (from Garman, 1899:pl. XI).

are some fine anatomical drawings of these peculiar fishes. Garman described seven species of slick-head, or alepocephalids, which remain a poorly known group. Oddly, there were very few lanternfishes in the trawls, but he described seven new species and lumped them all in the genus *Myctophum*, though there were existing genera available. Today the six valid species are each assigned to a different genus.

Garman was an authority on snailfishes, or liparids, having produced a monograph on them 7 years earlier (Garman, 1892). He described six new species from the *Albatross* material, of which only one has since been synonymized. Twenty-one of the 22 species of grenadiers were lumped into a single genus, though today they have been split into six genera, and eight of the species have been synonymized. Garman was not particularly receptive to the classification schemes of others,

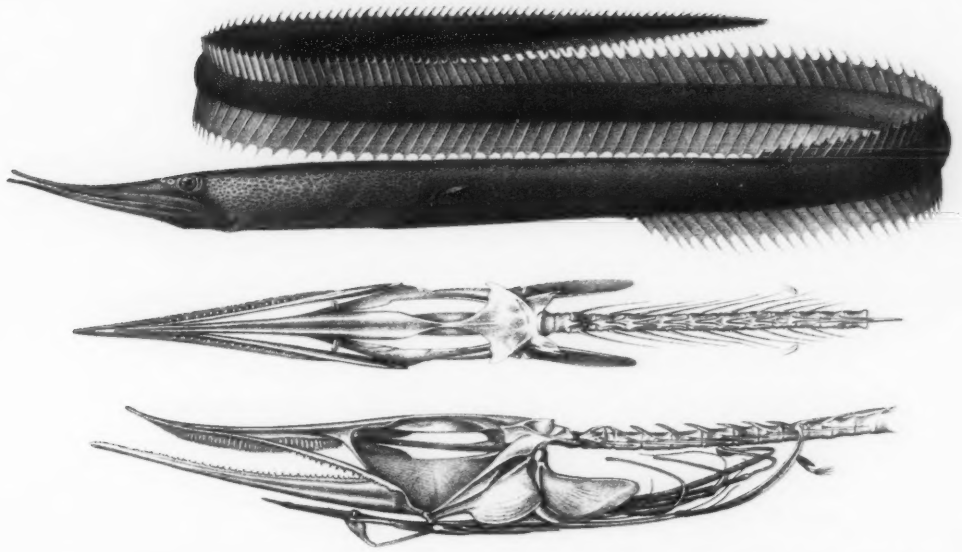

Figure 11.—The anguilliform *Serrivomer sector* Garman. The anatomical drawings are side and ventral views of the head and vertebral column of this sawtoothed eel. Drawn by J. H. Blake (from Garman, 1899: pl. LXIII).

including that of Jordan and Evermann (1896). This, more than anything, has led to the reassignment of many of his species to different genera. Twenty-five species of eels were described of which 15 are still valid. Garman described 14 eels based on adult material (Fig. 11) and 11 based on the leptocephalus larvae. In a practical move, he assigned the larvae to the genus *Atopichthys* since he knew that the genus *Leptocephalus* had been linked specifically to the congrid eels. The eel material is now placed in 6 families in 11 genera.

Summary

It should be clear from the list above that our knowledge of deep-sea fishes was greatly enhanced by the publication of the 1891 *Albatross* material. It is worth noting that MCZ *Albatross* voyages yielded this volume (Garman, 1899), 17 other monographic memoirs, and over 20 shorter bulletins covering both vertebrates and invertebrates. It is hoped that the presentation of the scientific legacy of the *Albatross* in this issue of the *Marine Fisheries Review* will increase the recognition of the value of collection based science and the vital role of field expeditions. There is currently little governmental support for non fisheries-related collecting expeditions such as those undertaken by the *Blake* and *Albatross*, and it seems clear that there should be.

Acknowledgments

Karel F. Liem has been, as usual, a source of inspiration. The current status of the various deep-sea fishes, as well as opinions about the impact of Garman's work on modern ichthyology, were provided by a number of colleagues. We would like to thank Jackie Webb, David Stein, Jim Craddock, Tomio Iwamoto, David Smith, Richard Rosenblatt, and Jørgen Neilsen. In addition, the staff of the Ernst Mayr Library at the Museum of Comparative Zoology has been very helpful throughout the preparation of this paper. While preparing this paper, APS was supported by NSF DDIG IBN9801636.

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A Century of Copepods: The U.S. Fisheries Steamer *Albatross*

DAVID M. DAMKAER

"You were kind enough to say something very complimentary about the work that has been done upon the collection of parasitic copepods. It does not seem to me as if the work was as worthy of credit as is the collection itself. This collection is the natural outcome of the activities of the Bureau of Fisheries extended over a long period of years. Beginning away back in the sixties of the last century someone has been collecting fish parasites pretty steadily ever since. The result is the present Museum collection . . . which is by far the largest and richest collection in the world."

—C. B. Wilson letter to W. L. Schmitt, 9 March 1922

Introduction

The marine invertebrates of North America received little attention before the arrival of Louis Agassiz in 1846. Agassiz and his students, particularly Addison E. Verrill and Richard Rathbun, and Agassiz's colleague Spencer Fullerton Baird, provided the concept and stimulus for expanded investigations. Baird, through the establishment of the U.S. Commission of Fish and Fisheries in 1871, provided a principal means (Hobart, 1995). This fortunate convergence soon created the *Albatross* (1882), a classic vessel at the center of the golden age of oceanography. For length of service, areas explored, and volumes written, the *Albatross* record is likely unsurpassed.

The *Albatross* (Fig. 1) was not the first vessel for the U.S. Fish Commission (Galtsoff, 1962; Nelson, 1971). The *Fish Hawk* (157 feet), built for near-shore investigations, was earlier by 2 years, and she worked longer by 6 years. The *Fish Hawk*, however, did not visit such exotic climes as the *Albatross* (234 feet), nor did she have such an army of distinguished investigators associated with her. The *Albatross* also reflected the experiences of other predecessors, the Coast Survey's *Bache* (1872) and *Blake* (1874).

The making and equipping of the *Albatross* has been told by others (Tanner, 1885a,b; Hedgpeth, 1945), and will be the stuff of many more fine stories to come. Likewise, *Albatross* journeys and accomplishments in far-flung geographic and academic fields will be reverently spoken of as long as men admire the sea (Agassiz, 1913; Andrews, 1929; Dunn, 1996a,b).

Tanner (1885a) described in incredible detail the equipment of the *Albatross* and how it was used. The men of the *Albatross* were as proud of her then as any of today's engineers would be of a satellite space station. A particularly engaging passage related to the commencement of trawling, in some cases to 1,000 fathoms:

> "When the vessel reaches the intended station the officer of the deck stops her with her stern to the wind, has the patent log hauled in, and then takes his station on the grating at the sounding machine, where he superintends the sounding, and maneuvers the vessel to keep the wire vertical during the descent. Having satisfied himself that the specimen cup is properly bent to the stray line, the sinker adjusted, the thermometer and water bottle clamped, the friction rope properly attended by a careful man detailed for the purpose, a man forward of the machine at the brake, one abaft it with the crank shipped, and another on the grating to attend the guide pulley, he will lower away gently until the apparatus is under water, then seize the small lead to the stray line, caution the record keeper to look out, have the pawl thrown back

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ABSTRACT—The marine invertebrates of North America received little attention before the arrival of Louis Agassiz in 1846. Agassiz and his students, particularly Addison E. Verrill and Richard Rathbun, and Agassiz's colleague Spencer F. Baird, provided the concept and stimulus for expanded investigations. Baird's U.S. Commission of Fish and Fisheries (1871) provided a principal means, especially through the U.S. Fisheries Steamer Albatross *(1882). Rathbun participated in the first and third* Albatross *scientific cruises in 1883–84 and published the first accounts of* Albatross *parasitic copepods.*

The first report of Albatross *planktonic copepods was published in 1895 by Wilhelm Giesbrecht of the Naples Zoological Station. Other collections were sent to the Norwegian Georg Ossian Sars. The American Charles Branch Wilson eventually added planktonic copepods to his extensive published works on the parasitic copepods from the* Albatross. *The* Albatross *copepods from San Francisco Bay were reported upon by Calvin Olin Esterly in 1924.*

Henry Bryant Bigelow accompanied the last scientific cruise of the Albatross *in 1920. Bigelow incorporated the 1920 copepods into his definitive study of the plankton of the Gulf of Maine. The late Otohiko Tanaka, in 1969, published two reviews of* Albatross *copepods.* Albatross *copepods will long be worked and reworked. This great ship and her shipmates were mutually inspiring, and they inspire us still.*

and the crank unshipped, and order 'Lower away!'"

With respect to the copepod crustaceans collected by the *Albatross*, it is essential to recognize the two principal, although artificial, copepod groups. These groups, the free-living and the parasitic copepods, are generally caught with different methods. On the *Albatross*, the parasitic copepods were mostly taken from fish, although copepods could be parasitic on most any marine animal, even whales. The free-living copepods were taken primarily by plankton nets, which would catch pelagic as well as occasional bottom-dwelling copepods. In some plankton samples, free-swimming stages of parasitic copepods were encountered.

I am pleased to record that copepod investigators were present on the first and the last *Albatross* cruises, and that considerable and praiseworthy attention was given to copepods throughout and beyond the active life of this famous oceanographic ship. Most of the promising young men who sailed with the *Albatross* had brilliant careers. This great ship and her shipmates were mutually inspiring, and they inspire us still.

A. E. Verrill and S. I. Smith

The *Albatross* was launched in an undercurrent of anticipation of an immense harvest of little-known marine life. Those who would go down to the sea for invertebrates were not the prime movers of the *Albatross*, for its essential task was always toward vertebrate fisheries research. However, persons of influence recognized direct and indirect links between fish and invertebrates, such as the copepod crustaceans, and their study was encouraged in those early days. The Fish Commission had no staff for this work, so it was obliged to accept outside help.

Indeed, the very first annual report of the Commissioner of Fisheries summarized the essential knowledge of American marine invertebrates to that time (Verrill and Smith, 1873). There had been nothing approaching this in the generation since Gould's 1841 pioneer report on the invertebrates of Massachusetts. Verrill and Smith's large volume

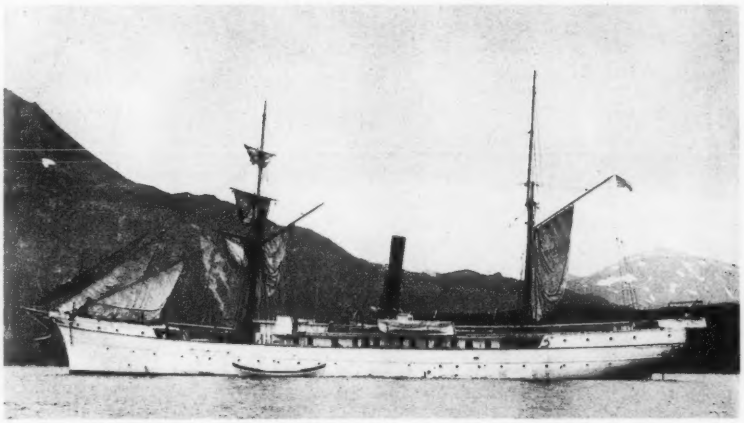


Figure 1.—U.S. Fisheries Steamer *Albatross* under partial sail in Alaska (from Townsend, 1901).

was a major advance in ecology of our seas. Although there was considerable new information on many invertebrate groups, especially mollusks (Verrill) and large crustaceans (Smith), one found little on copepods:

> "The . . . minute Copeopoda [sic] of our coast have not yet been sufficiently studied by any one for us to attempt to enumerate even the more common species" (Verrill and Smith, 1873).

Only 20 copepod species were included, and all but one of these were parasitic. This was the basis on which the *Albatross* copepod collections began. [In Verrill and Smith's taxonomy, the old lower-crustacean group Entomostraca included the "Copeopoda" (apparently only the planktonic species, and here only *Sapphirina* sp.) and the Siphonostoma, the parasitic species (19 listed, all from fishes). In early references, the advanced parasitic forms were sometimes also referred to as "lernaeids."]

Addison Emery Verrill (1839–1926) had been a student of and assistant to Louis Agassiz at Harvard's Museum of Comparative Zoology. In 1864, Agassiz recommended Verrill to Yale, where he remained for 43 years as Professor of Zoology. Verrill continued his studies of invertebrates along the northeast coast. Responding to Baird's desire to investigate the environment of the commercial fishes, Verrill began comprehensive surveys for the Fish Commission in 1871 (Coe, 1930).

Verrill was at the center of America's major growth in zoology from Agassiz's prime through the experimental era of the first quarter of the 20th century. Verrill participated in the general trend of zoological fashion from taxonomy, to evolutionary adaptations, to embryology, and to experimental physiology and genetics. However, taking a long look back at his work, the single item that probably still brings the greatest recognition is the 1873 report on the northeastern invertebrates.

In this monumental study, Verrill was ably assisted by his brother-in-law Sydney Irving Smith (1843–1926). Smith (Fig. 2) had followed Verrill to Yale as a student; in the following year, Verrill married Smith's sister. In 1867, Smith became Verrill's assistant, coworker, and eventually coauthor on the Fish Commission's invertebrate report (Coe, 1929). In 1875, Smith was appointed Professor of Comparative Anatomy at Yale. He was also one of the founders of the Marine Biological Laboratory at Woods Hole.

R. Rathbun

Richard Rathbun (1852–1918) (Fig. 3) was linked to the *Albatross* even before it was afloat. That he became the first

Figure 2.—Sydney Irving Smith (1843–1926) (USNM photograph).

Figure 3.—Richard Rathbun (1852–1918) (from Benjamin, 1918).

scientist to report on the enormous numbers of copepods collected from this celebrated ship gives him a prominent part in the present narrative. He was born in Buffalo, N.Y., and at age 15 began a 4-year apprenticeship as a clerk for his father's contracting and stone business. At this early age, Rathbun had a fascination with fossils of western New York, finding the first in his father's own quarries (Rathbun, 1969). His collections and studies of these, and his obvious knowledge and enthusiasm, led him even then to the honorary post of curator of paleontology at the museum of the Buffalo Society of Natural History. At the urging of Charles F. Hartt (an Agassiz pupil and Professor of Geology at Cornell), Rathbun began science studies at Cornell University in 1871 (Benjamin, 1918; Coe, 1918).

Rathbun's first publications, on fossils, began at this time. His research soon brought him to Cambridge, Mass., where he took classes from Louis Agassiz at the Museum of Comparative Zoology in 1872–73, Agassiz's last years. In September 1873, Rathbun was on the *Bache*, dredging invertebrates off the coast of Maine with A. S. Packard, at that time an Agassiz assistant. Rathbun remained at Cambridge until 1875. During his summers there, he began his long association with Spencer Baird, at first as a volunteer scientific assistant.

In 1875, Rathbun joined Hartt's staff, in Brazil, where Hartt was conducting a geological survey. Rathbun's interests were particularly in coral reefs and fossils. When Hartt died of yellow fever in March 1878, Baird offered Rathbun a position as a paid Scientific Assistant in his new U.S. Fish Commission. Rathbun was detailed to Verrill at Yale where, although Verrill was in charge of the work, Rathbun had day-to-day responsibility, making many invertebrate collections over the following 2 years. Rathbun, although based at various offices, retained this formal position with the Fish Commission through 1896 (Benjamin, 1918).

Rathbun was therefore a protégé of both Agassiz and Baird. Through Baird, Rathbun also spanned both the Fish Commission and the growing U.S. National Museum (USNM), and continued the close relations between the two institutions. In 1880, with a new National Museum building, Rathbun transferred to Washington, D.C., and was assigned as Curator of the Department of Marine Invertebrates. Rathbun thus joined an eager community of biologists in the Nation's capital, in time to be one of ten founders of the Biological Society of Washington, for which he was secretary until 1888. In 1880 and 1882, Rathbun was on the *Fish Hawk*, surveying fishery resources out to the Gulf Stream:

> "At each dredging station, collections were made with the towing net [Fig. 4], which is designed to scoop in the free-swimming forms, living at the surface and at intermediate depths. . . . The animals obtained [included] copepods, the latter frequently occurring in countless numbers. They serve as food for the surface-swimming fish, such as menhaden and mackerel" (Tanner, 1884).

As both the USNM and the Fish Commission grew, Baird relied more and more on Rathbun for administrative duties, until Baird's death in 1887. This turned Rathbun into an administrator of remarkable ability.

One of the essential housekeeping chores was the review and recording of the earliest lists of stations and activities of the Fish Commission, copublished by Rathbun (Smith and Rathbun, 1882). This was followed by a number of summaries of North Atlantic fisheries, including accounts of the natural history of crustaceans, worms, echinoderms, and sponges, comprising altogether more than 500 pages (Coe, 1918). This was his best zoological

work, and it established Rathbun as an authority on the investigation and economics of marine zoology.

Rathbun's first obvious connection with the *Albatross* was his role in the preparation of the extensive catalog accompanying the U.S. exhibit at the "Great International Fisheries Exhibition" in London in 1883. Rathbun authored a section on the economic crustaceans, worms, echinoderms, and sponges. In a second section, he reviewed the "apparatus of scientific research" (Rathbun, 1883). The U.S. exhibit outlined fisheries work by American scientists, particularly from U.S. Coast Survey and Fish Commission vessels, but the *Albatross*, her equipment, and expected scientific harvest, was the main feature of the presentation.

Baird had planned to move Rathbun wholly into the USNM, but after his death, George Brown Goode (1857–1896), the interim Commissioner of Fisheries, persuaded Rathbun to retain his Fish Commission position. During this time, Rathbun assisted the international fur seal commission and thereby continued with the results of *Albatross* investigations through 1896. In 1892, he was the U.S. representative for fisheries on the Boundary Commission and visited both coasts and the Great Lakes, from the Gulf of St. Lawrence to Cape Flattery. Rathbun's extensive reviews of the Nation's fisheries (e.g. Rathbun, 1884, 1899) are classics of their kind. Altogether, Rathbun published about 100 papers. In 1894, Rathbun was given an Honorary Doctorate by Bowdoin College, and he included among his many affiliations, membership in the American Fisheries Society.

Rathbun did not leave the Fish Commission until after Goode's successor, Marshall McDonald, died in 1895. Rathbun began working solely for the USNM on New Year's Day 1897. His previous work there ensured an extraordinarily rapid rise. Within a month, Rathbun was Assistant Secretary of the Smithsonian Institution, the parent organization of the USNM, in which, as an old habit, he retained his other official title. In mid 1898, he was named Director of the USNM. He held this position until 1914, and the Smithsonian's until his death in 1918:

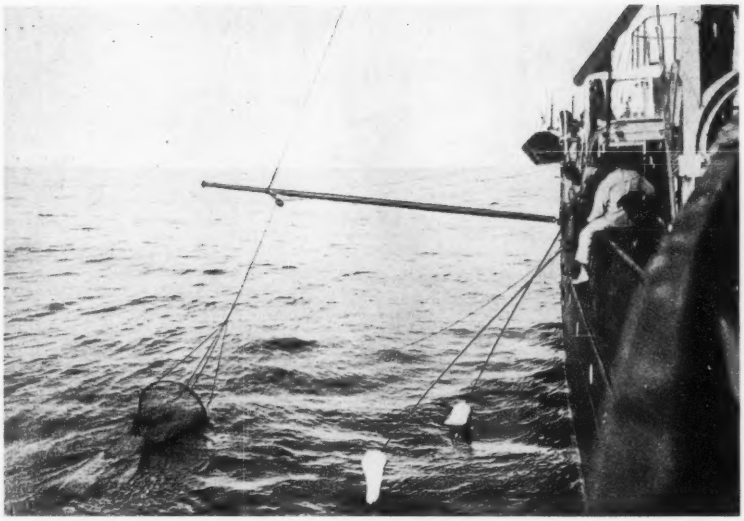


Figure 4.—Surface net and dip nets in use on the *Albatross* (from Townsend, 1901).

> "Absorbed in the details of his various activities, all of which had to do with the institution to which he gave his life, he had but little time for other interests" (Benjamin, 1918).

One of Rathbun's great accomplishments, from 1913, was the present Natural History Museum building, where I was employed for several years, and where Rathbun was still remembered with fondness. (Rathbun's attention to every detail of the planning and construction of this building ensured him the repetitive duty with respect to the building of the National Gallery of Art.) Waldo L. Schmitt (1887–1977), who had been Naturalist on the *Albatross*, was the protégé of Rathbun's sister, Mary Jane Rathbun (1860–1943), crustacean specialist at the USNM. Through their close relationship, Richard Rathbun extended every courtesy to Schmitt, who spoke of him often and with great respect. I was privileged to consider Schmitt a friend in the last decade of his life; I was that close to the *Albatross*.

The *Albatross* was taken on a preliminary cruise in March 1883, when much of the equipment was tested. Baird's orders, dated 10 April 1883, for the first *Albatross* scientific cruise concluded thus:

> "You will give to the naturalist of the expedition all possible facilities for collecting and preserving such specimens as you may meet during the cruise.
>
> "P. S.—The operations of dredging and trawling should be carried on as frequently as opportunity offers. . . ." (Tanner, 1885b).

The *Albatross* then put to sea on 24 April, and the first "official" sampling was with a beam trawl at Station 2007 on 27 April between Washington and Norfolk, Va.

The earlier parts of Tanner's (1885b) report of the first *Albatross* year spoke mainly of fish, but soon the response to Baird's orders "to determine . . . the biological peculiarities" of the New England seas became evident as detailed observations and the concurrent excitement of Verrill's crew reached the Commander. With "the naturalists finding no difficulty in picking over the contents of the trawl," log-book entries indicated the examination of the surface and gills of fish for parasites. By May, with "many new and interesting forms

having been brought up," Commander Z. L. Tanner (1835–1906) was making familiar entries of salps, foraminifera, globigerina, large red crabs, starfish, squid, "coral growth," barnacles, and lobsters, reflecting the growing interest of all in that portion of the harvest. Some of these notes mentioned genera; "minute crustaceans" sometimes made their way into the ship's logs. "A number of naturalists" (July) became "a large party of naturalists" (September), and produced "many valuable specimens." In October, "all the fish taken were carefully examined for parasites."

In spite of the careful handling of ship and equipment, "the trawl was lost" was an all-too-common entry in the early reports. In one case, the Commander stated that

> ". . . the accident was the result of kinking and the fault rests between myself and the dredge rope. I have not yet been able to judge satisfactorily which is responsible for the frequent losses during our present trip" (Tanner, 1885b).

One mystery for which the *Albatross* was charged was to determine what Atlantic menhaden, *Brevoortia tyrannus*, eat. The skipper of a fishing boat met at sea in August said that "their food is a very small marine insect, which appears under the microscope to be a species of crab" (Tanner, 1885b). This is not a bad description of copepods, which, of course, make up a large part of the food of the filter-feeding menhaden. Therefore, it soon was apparent that menhaden, unlike Atlantic cod, *Gadus morhua*, were not "ground grubbers," which was commonly held, nor did menhaden eat mud. Another old fisherman, speaking of the food of mackerel, *Scomber* spp., said that it "consists in part of what is known among fishermen as 'cayenne,' only seen when the water is very smooth. It then appears to skip out of the water." This is an early American reference to the surface swarming of the copepod *Calanus* (and others), a phenomenon by then well known to Scandinavian biologists (Gunnerus, 1770).

Copepods also surfaced briefly in the report of the *Albatross*'s first Naturalist, James E. Benedict (Tanner, 1885b). Underwater lights were often used, typically just beneath the surface, aiding in the capture of several surprising forms. Among these were "early stages of various Copepods," passed to Professor Sydney Smith.

Richard Rathbun participated on various legs of the first scientific cruise of the *Albatross*, in 1883, dredging and trawling from Woods Hole to the Gulf Stream until 14 November, when the *Albatross* tied up in the Washington Navy Yard. Among the invertebrates which attracted Rathbun most were parasitic copepods found on fish. Rathbun also was on the third *Albatross* cruise, in the same area, in 1884, and from 1885 to 1887 he published the first three accounts of *Albatross* copepods (Rathbun, 1885, 1886, 1887).

Rathbun published pre-*Albatross* lists of invertebrates from the collections of the USNM (Rathbun, 1882a, b); these mentioned copepods, but only from the *Fish Hawk* or from the Commission's work along the northeast coast. The first *Albatross* copepods, parasites of fish, were listed and described by Rathbun in 1885. At that date, in the museum collections, there were 22 identified species of copepods (not counting 4 species of argulids, then classified as copepods), of which 9 were from *Albatross* Cruises 1 and 3 off the northeastern United States. The various legs of these first two Atlantic cruises were under Verrill's direction, but Verrill himself apparently never shipped on the *Albatross*.

Rathbun (1886) followed soon with a second publication on parasitic copepods. This included figures for three new species of *Chondracanthus* taken during the *Albatross* first cruise, in 1883, as well as a second *Albatross* record (1885) for a previously reported species.

In a third and final report, Rathbun (1887) described three new species of parasitic copepods from *Albatross* collections, taken from sharks, menhaden, and bluefish, *Pomatomus saltatrix*, in Vineyard Sound or off Florida.

Before leaving Rathbun's direct participation, it must be noted that Verrill (1885) published a large report on general invertebrates collected by the *Albatross* during 1883. Verrill acknowledged that "very interesting additions to our collections were made in nearly every class." His particular interest was in the mollusks. Smith studied the crustaceans, principally the decapods, while Rathbun dealt with the copepods. The only copepod specifically mentioned by Verrill was found on a red sea anemone, of unpleasant if not dangerous stinging abilities, common below 150 fathoms:

> "A very singular, large, soft, pinkish Lernean crustacean (*Antheacheres duebenii* [Michael] Sars, fig. 167–8) lives parasitically in the stomach of this Actinian, with which it agrees in color. It is not uncommon" (Verrill, 1885).

In another section, it was acknowledged that

> ". . . the Copepoda . . . are very abundant, both in the lots obtained in the trawl-wings and in the surface collections. Very many fine species were noticed, but they have not yet been reported upon by Mr. Rathbun, who has charge of [this group]. He has studied a number of interesting and novel forms of Lerneans found parasitic on several of the deep-sea fishes" (Verrill, 1885).

The trawl wings (Fig. 5) were muslin nets attached so as to be just above the bottom at the ends of the trawl frame. These were first used by Verrill on the *Fish Hawk*. Verrill noted that many pelagic species which were not caught at the surface were collected in the trawl wings, but that the precise depth of collection could, of course, not be determined.

For the Gulf Stream,

> "Copepod crustaceans are usually the most abundant forms of small surface animals, occurring in great quantities and of many genera and species. Various species of the genus *Calanus* are the most common. Several species of the genus *Sapphirina* were taken, some of them very brilliant in colors" (Verrill, 1885).

Verrill's report only hinted at what were to become overwhelming numbers of pelagic copepods in the *Albatross* collections.

The second, the longest, and the most important period of the *Albatross* began at the end of 1887 (Hedgpeth, 1945; Nelson, 1971). In describing the departure of the *Albatross* for the Pacific Ocean on 20 November, Commander Tanner wrote that

> "It is seldom the fortune of men to start on a long voyage under more favorable auspices. The ship was well equipped and thoroughly seaworthy in every respect. She had on board an efficient corps of officers and scientists, and her crew could not be excelled" (Tanner, 1891).

The *Albatross* sampled around South America, via the Strait of Magellan, and reached San Francisco 11 May 1888, 4 days ahead of schedule.

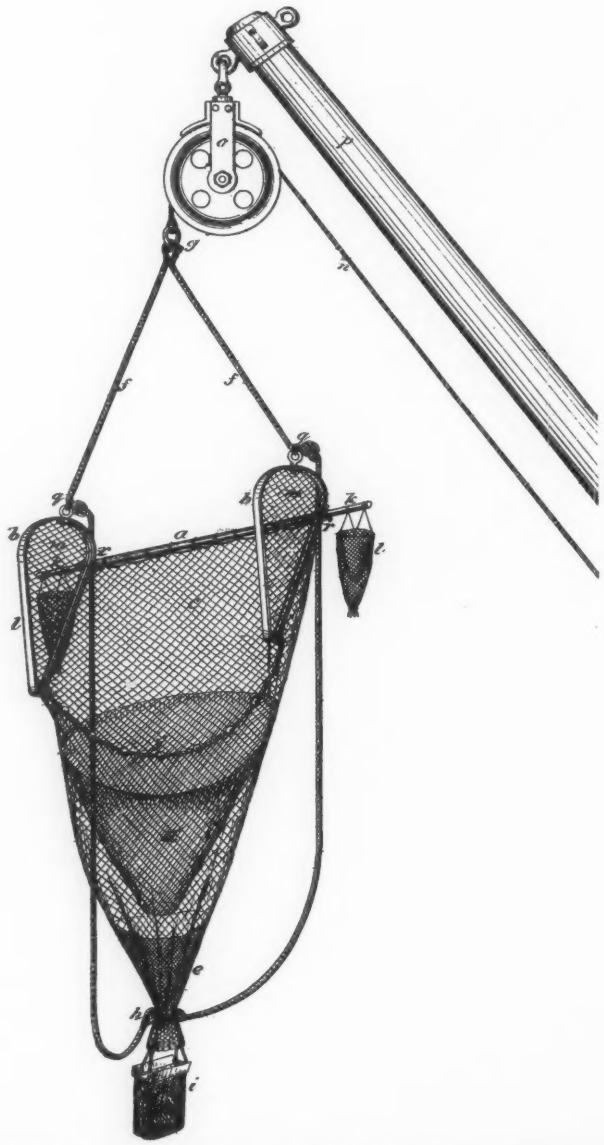


Figure 5.—The improved beam trawl, with trawl wings, as used on the *Albatross* (from Tanner, 1885a).

W. Giesbrecht

The *Albatross* collected vast numbers of planktonic copepods, especially in the Pacific Ocean. The first report of these was published in 1895 by Wilhelm Giesbrecht (1854–1913), the virtuoso German copepodologist on the staff of the Naples Zoological Station (Damkaer, 1995b).

Giesbrecht (Fig. 6) was born in Danzig and earned a doctorate at the University of Kiel. An appointment as guest researcher at Naples in 1881 resulted in a lifetime position. Giesbrecht's major effort was the unexcelled 1892 monograph on pelagic copepods. Giesbrecht was the first to clearly show that parasitism arose independently at several phases of copepod evolution, and through consideration of morphological development, he removed the prevailing distinctions between free-living and parasitic copepods. Through his writing and artistic skills, he was a respected editor at Naples and for other publishers.

The Giesbrecht (1895) copepod collection was from the 1891 *Albatross* cruise through the warm Pacific from California to the Galapagos. This was the first of three cruises under the direction and patronage of Alexander Agassiz, esteemed son and student of Louis Agassiz. Ironically, this exotic region had been traversed by the U.S. Exploring Expedition (1838–1842), the *Challenger* (Great Britain, 1872–1876), and the *Vettor Pisani* (Italy, 1882–1885), with the copepods incorporated into classic publications. Giesbrecht himself published several reports on copepods from the latter cruise, and he summarized these in his well-known 1892 monograph.

Although the number of individual copepods was small, this *Albatross* collection, only 32 samples, contained a large number of species; this now well-known feature of tropical waters was not so obvious in the early days. As a supplement to earlier work, Giesbrecht had a keen interest in the collection. Most samples were from the surface, but there were some reaching 200 to 600 m, and one to 3,000 m. Three samples had been obtained with a closing net (Fig. 7). From the deep-sea samples, Giesbrecht suggested that some surface forms from cold-water regions were living at depth in the warm-water regions. This is another notion that has firmed with time. Giesbrecht also found special interest in the species which were common to both the Atlantic and Pacific. Giesbrecht discussed 48 *Albatross* copepod species, describing and illustrating 10 new species and 3 new genera.

Giesbrecht honored both Alexander Agassiz and Lt. Commander Z. L. Tanner through the new copepods *Pontella agassizi* and *Heterochaeta tanneri*.

Figure 6.—Wilhelm Giesbrecht (1854–1913) (Naples Zoological Station photograph).

G. O. Sars

Other *Albatross* collections of pelagic copepods were sent to the Norwegian Georg Ossian Sars (1837–1927), who died with his report less than half completed. The material comprised seven distinct collections: 1) around South America and through the eastern Pacific (1887–88), 2) across the tropical Pacific to Japan and Kamchatka (1899–1901), 3) Hawaiian Islands (1902), 4) California and south (1904), 5) Alaskan salmon (1903, 1905), 6) Northwest Pacific (1906), and 7) the 3-year cruise to the Philippines (1907–10), with the most specimens. Sars sorted and labeled about 40% of the copepods (those collected before 1905) in this large assortment, and he made drawings of new species, at which time he felt an obligation to an earlier study on the copepods collected by the Prince of Monaco. Sars devoted the rest of his life to finishing that exquisite monograph and never looked at the *Albatross* copepods again.

Sars (Fig. 8) was the son of Michael Sars, a priest turned world-class zoologist. Ossian Sars's international fame was based on his revelation that most of the commercial fishes had planktonic eggs and larval stages. His interests then moved toward the lower crustaceans, and during the next 60 years, his production of definitive and well-illustrated monographs made him the best-known Norwegian zoologist. He became a professor at the University of Christiania. He was a planner, participant, and reporter for the Norwegian North Atlantic Expedition (1876–78). Another acclaimed publication was Sars's account of the copepods collected by his brother-in-law, Fridtjof Nansen, during the Norwegian North Polar Expedition (1893–96). Sars, as many of his efforts proved, was not averse to field work. Indeed, his ingenious applications are still appreciated by those who would again collect material revealed by him. However, the enormous numbers of specimens sent to Sars from all over the world ensured that he would remain near his laboratory (Damkaer, 1993).

After Sars's death, the *Albatross* collection, with Sars's notes and drawings, was returned to the USNM, and the work was taken up by C. B. Wilson, who added the plankton copepods to his already extensive published works on the parasitic copepods from the *Albatross*. A measure of the task may be suggested by the fact that Wilson, too, died with the work far from complete.

C. B. Wilson

Charles Branch Wilson (1861–1941) probably never looked seriously at a copepod until he was 35 years old, when he became a professor, and later head of the science department, at the State Normal School in Westfield, Mass. Before that time, he had experimented with embryonic development of amphibians. Opportunities for field work in Jamaica and in California in 1897 and 1899, respectively, turned most of his energy toward parasitic marine copepods. In fact, by expressing a solid interest, Wilson received the mantle from Rathbun and became his protégé:

> "I am pleased to know that some one has again taken up the subject of parasitic crustaceans in this country, and trust that you may be able to make good progress in the work. Some years ago I made quite a collection in that line at Woods Hole and elsewhere along the coast, but lack of opportunity

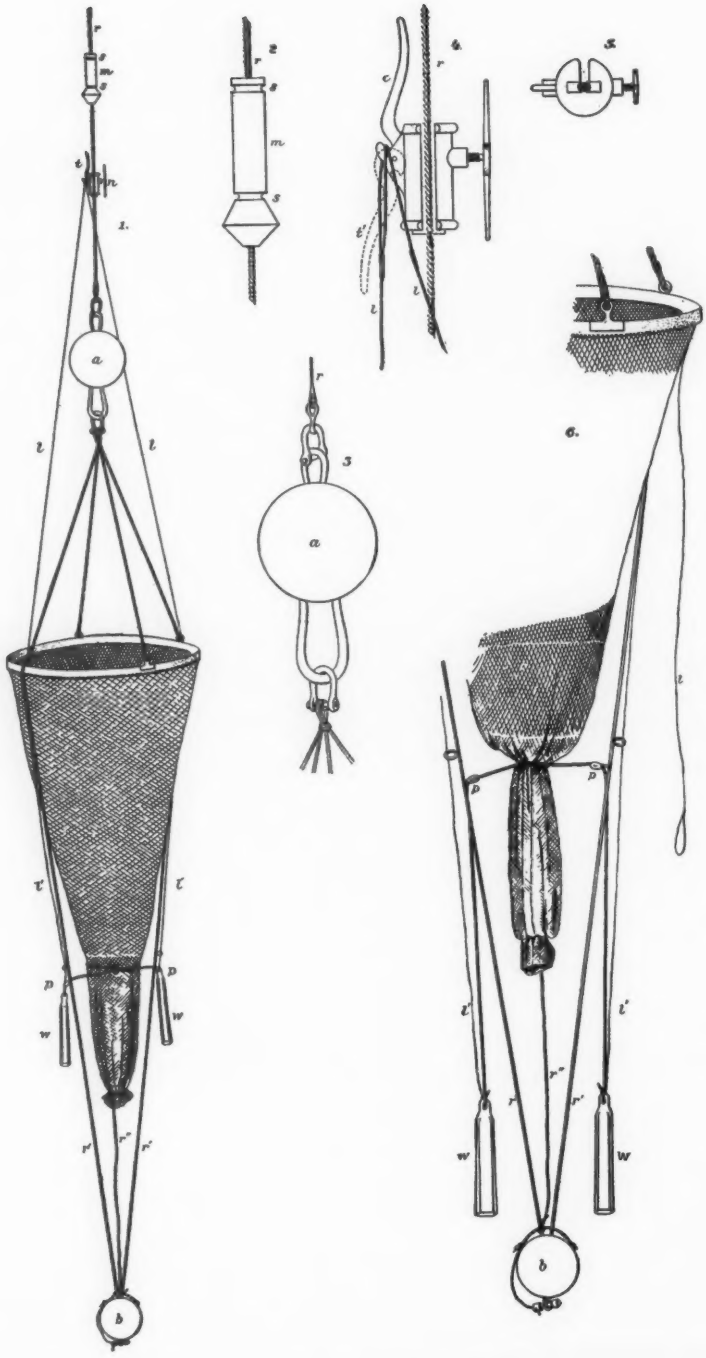


Figure 7.—Tanner's first closing net, as used on the *Albatross* (from Tanner, 1893).

to work them up accounts for the little I have published. The specimens are now here in the National Museum in good condition. Would you care to study and report upon them to the Museum? As I recall it, there are still several undescribed species and much else of interest in the material. I shall be glad to hear from you on the subject at your convenience. Yours very truly, Richard Rathbun, Assistant Secretary" (24 September 1900).

Wilson (Fig. 9) joined the circle of independent Fish Commission researchers in 1901 by spending the first of many summers at the Woods Hole Laboratory. He took up the parasitic copepods with a vengeance, and for a generation no one in this country, and few abroad, came even close to his output and quality (Damkaer, 1995a). Like Sars, Wilson was the recipient of many specimens from around the world, as his long list of publications clearly shows.

Most of Wilson's copepod papers were published by the USNM. Wilson's papers can be grouped somewhat arbitrarily as systematic reviews (source not stressed) or as summaries of geographically limited collections. Not surprisingly, the collections available to him included many specimens from the *Albatross*.

In the first category are eight reports describing *Albatross* copepods. The first, Wilson (1905), was based mainly on Fish Commission collections off the U.S. east coast. Rathbun had turned over to Wilson all of his lists and notes from preliminary work on this collection. Although some *Albatross* copepods were mentioned, including some taken on the trip around South America and in the Pacific, the source was not given for all specimens; USNM records would have to be revisited to determine the exact number of *Albatross* copepods from this study. The emphasis in the report was on hosts, descriptions, and redescriptions of species. Recall that many "good" parasitic copepods had been described from hosts obtained at markets, and that the precise location was less important in those days than a

description of the species. Among the accounts of 36 caligids were 10 from the *Albatross*, including a new genus and 6 new species, one of which had been attracted by the electric light. Typical for Wilson's papers, there was an excellent review of the literature.

The next two papers, Wilson (1907 a,b), reported three *Albatross* species, one of which, from 1887–88, was new, and from various Atlantic and Pacific localities, about 20 species from the *Albatross*, one of which was new.

A large and well-known monograph covering marine and freshwater parasitic copepods of Wilson's (1915) Lernaeopodidae included ten *Albatross* species, seven of which were new. One of the latter was *Brachiella nitida*, found in the mouth of the fish *Albatrossia pectoralis* from a 1906 North Pacific locality. A companion report on the Lernaeidae (Wilson, 1917) described 13 Atlantic and Pacific *Albatross* species, of which 9 were new species. Three new lernaeid genera from the *Albatross* collections were introduced. A following report (Wilson, 1919) dealt with four Atlantic and Pacific *Albatross* species, three of which were new. A new genus was described from *Albatross* collections off New Jersey in 1883. Wilson (1924) reported two *Albatross* copepods, one from British Columbia and one from the Strait of Magellan. The date of the latter collection, stated as 1908, cannot be correct; conversely, perhaps the locality is incorrect.

The final paper in this group of systematic reports is Wilson (1944), completed only a few weeks before he died. Therefore, this was the last paper of Wilson's own doing. Only one copepod species was clearly from *Albatross* collections, and this represented a new genus and species from the New Jersey coast.

In Wilson's papers based on geographically limited collections are six with *Albatross* material. The first is Wilson (1908) on parasitic copepods found on fishes of the Pacific coast, with descriptions of new genera and species; "some of them are the result of work done upon different expeditions of the steamer *Albatross*." Except for two lots sent directly to Wilson (one from

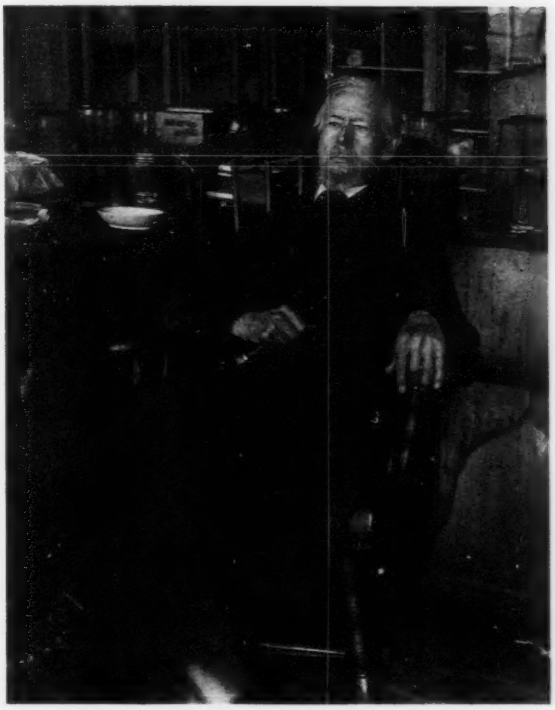


Figure 8.—Georg Ossian Sars (1837–1927) (photograph ca. 1925 by Hjalmar Broch, University of Oslo),

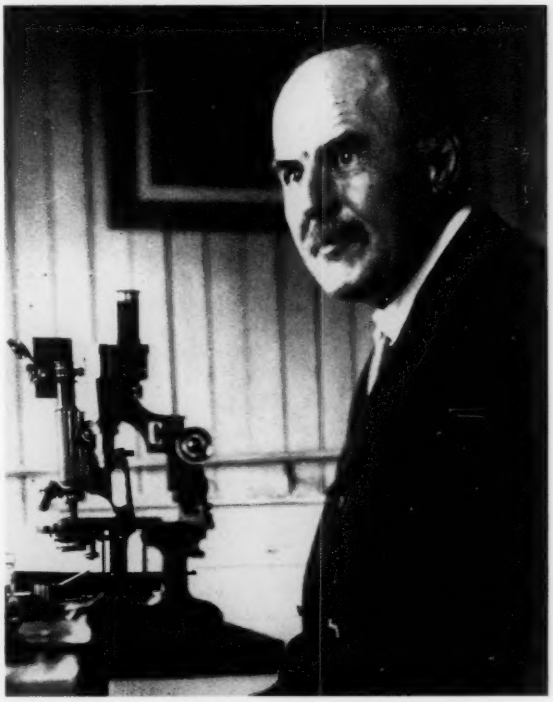


Figure 9.—Charles Branch Wilson (1861–1941) (photograph ca. 1925 by Marine Biological Laboratory, Woods Hole).

Ritter collected in 1904 and another from Kofoid), all *Albatross* specimens were sent to Wilson via the USNM. Of 13 *Albatross* species, 4 were new; Wilson also described one new genus.

Two new copepods, one from an echinoderm in Japan and the other from a Hawaiian mollusk, were reported from *Albatross* collections in Wilson (1921). Wilson (1923) described a new genus and species of parasitic copepod from a Lower Californian annelid dredged by the *Albatross* in 1911.

Wilson's (1932) "Copepods of the Woods Hole region Massachusetts" is likely the most-used American publication on copepods—the copepod "bible" for a generation, and still a ready companion for those working in the North Atlantic. Wilson defined this region as ca. 200 miles wide and 150 miles long:

> "Any reduction of the area would of necessity eliminate some of the excellent material gathered during the earliest cruises of the . . . *Albatross*. As these were all included in the notes and drawings made by Dr. Richard Rathbun, it has been deemed best to keep the collection intact."

Rathbun spent his summers and early autumns during 1880–85 at Woods Hole, and his investigations formed the basis of this classic work. He made copious notes regarding living forms and their colors. For marine copepods in this area, northern and southern faunas overlap, so diversity is high, and a

> ". . . remarkable feature of the present collection is the large number of species that have never before been reported from the Woods Hole region . . . [or] anywhere along the Atlantic shores of North America. . . . How does it happen that so many species escaped the attention of those investigators . . . already mentioned? The first answer is suggested by a perusal of the notes and records made by Doctor Rathbun and his associates. They were exceptionally thorough in their search, and their task was accomplished long before the introduction of any agitation in reference to an 8-hour working-day. . . . Evidently in the interests of science a 17-hour day was not deemed impossible by those enthusiasts.
>
> "If all this wealth of material be considered in connection with the several papers that Doctor Rathbun published, it can easily be seen that he would have become one of the foremost authorities upon copepods, had not his executive duties compelled him to give up research work. It is, therefore, eminently appropriate that the present paper, which embodies so much of his work, be dedicated to his memory" (Wilson, 1932).

The *Albatross* was in the Atlantic for only a relatively short time, although virtually all marine copepods reported in Wilson (1932) could have been collected from that ship. Most of the copepod species were from *Grampus* collections, which may have had a higher priority. Noted from the *Albatross* were 57 calanoid species and 11 species from other groups, including a new genus and species. This represents 18% of the 373 copepods reported and described in this monograph. Many of the other copepods were from fresh water or brackish ponds and beaches. Wilson included a key to all the known copepod genera, worldwide, ensuring the broad and lasting value of this work.

Wilson's (1935) report on parasitic copepods from the Pacific coast supplemented Wilson (1908) by adding three species from the *Albatross*, one of which was new and named for Ed Ricketts of "Cannery Row" fame (Hedgpeth, 1978a, b). Other specimens came from Stanford University and University of California collections.

In Wilson's publications covering *Albatross* copepods, only the last, Wilson (1950), dealt exclusively with this collection. Wilson died in 1941, and his colleagues at the USNM, especially Waldo L. Schmitt, completed the references, edited the records, and brought this report to publication.

The *Albatross* Atlantic forms were addressed in "Copepods of Woods Hole"—the remainder, from tow nets and dredging in the Pacific Ocean (i.e. plankton copepods), essentially the same samples that had been sent to Sars, was covered in Wilson (1950). This collection comprised thousands of mostly surface samples; in amount and coverage of plankton, these compared with the greatest collections to that time: U.S. Exploring Expedition, *Challenger*, Prince of Monaco cruises (1885–1914), *Siboga* (1899–1900), and the *Carnegie* (Wilson, 1942). Altogether, from the *Albatross*, there were 473 copepod species (including one larval *Pennella*, a parasitic copepod), of which 29 were new. Males of pelagic copepods are frequently scarce, and this collection provided previously unknown males for 26 species. From similar areas traversed by other expeditions, 93 species were found only by the *Albatross* (including, of course, the 29 new species); only 12 species were on all of the lists.

The methods employed on the *Albatross* were not quantitative, and there were few comparisons of numbers. The nets were 1) surface ring nets, 12 in to 5½ ft; an electric light added to numbers of copepods captured; 2) paired ring nets for horizontal and vertical tows, sizes to 10-ft diameter; 3) ca. 3-ft diameter closing nets at intermediate depths:

> "A good start has been made toward a knowledge of the surface plankton, but it is only a start, and a broad field is still left for future investigation and discovery. Many species have been obtained in vertical hauls from considerable depths, but we have absolutely no definitive knowledge as to where they entered the net" (Wilson, 1950).

Each species was described, and many were illustrated. Each station is listed separately (location, depth, date) with the species found there. Wilson was lavish in his praise for Sars and the preliminary work on this collection; if not for the rules of nomenclature, Sars would have been credited with many new species. Wilson (and his colleagues) included an exceptionally good

literature list, which has been my constant companion for 40 years.

Therefore, the *Albatross* copepods reported by Wilson in 14 publications comprised 623 pelagic and parasitic species, including 66 new species and 9 new genera. The numbers would be larger if the *Albatross* argulids, no longer held as copepods, were included.

Wilson retired in 1932 but retained his laboratory at Westfield, Mass., and returned in summers to Woods Hole. Toward the end of his life, through the urgings of Schmitt, Wilson was persuaded to take on the planktonic copepods from the *Albatross*. Schmitt had more than one regret over this; first, because he felt that the task contributed to Wilson's death, and second, that Wilson was never able to give the planktonic copepods the deliberation that he might have as a younger man. The day before Wilson's death, Schmitt visited him at Westfield, where Wilson went over the *Albatross* records and showed Schmitt some of the recent additions to his

> " . . . incomparable library of copepod literature that he had built up in the course of a busy lifetime. . . . [Wilson was] one of the most valued scientific collaborators on the rolls of the Museum. He bequeathed to the Museum his library of copepod literature, which is perhaps the most complete of its kind in the world" (Schmitt, 1941).

Wilson's library has been kept up to date as a distinct world-class resource.

Many of Wilson's classic papers on parasitic copepods, systematically dealing with groups worldwide, included annotated literature reviews that have never been surpassed. In contrast, his papers on planktonic copepods from the *Albatross* (Wilson, 1950) and the *Carnegie* (Wilson, 1942) were essentially limited to the specific collections, no doubt due to the necessities of posthumous editing:

> "Dr. Charles Branch Wilson, the last of that outstanding group of great monographers of the marine copepods which included Brady, Dana, Giesbrecht, Sars, and Thomas and Andrew Scott, died August 18, 1941" (J. A. Fleming of the Carnegie Institution *in* Wilson, 1942).

C. O. Esterly

In 1912 and 1913, the *Albatross* surveyed the biology and hydrography of San Francisco Bay in a cooperative effort by the U.S. Bureau of Fisheries (the U.S. Fish Commission was renamed in 1903) and the University of California. Francis B. Sumner (1874–1945) was Naturalist for the Bureau, and Charles A. Kofoid (1865–1947) represented the University. Waldo Schmitt was a Scientific Assistant.

Nearly 200 stations were occupied throughout San Francisco Bay, from January 1912 until July 1913. Plankton samples were collected approximately every 2 months; often there were multiple plankton samples at a particular station. Although he did not participate in the *Albatross* cruises, the separated copepods from these samples were sent to C. O. Esterly (Fig. 10) for his identifications and report.

Calvin Olin Esterly (1879–1928) had already distinguished himself in this area by publishing the first comprehensive accounts of copepods from the U.S. west coast. The San Francisco Bay report (Esterly, 1924) supplemented Esterly's long series of papers on the systematics and distribution of pelagic copepods from the San Diego region, beginning in 1905. From the San Francisco Bay samples, Esterly described 11 species and their marked seasonal abundances. The bay-wide distribution of four species was related to salinity. Esterly's characteristically practical illustrations make this report useful still.

Esterly was born in Texas and earned a B.A. from the University of California in 1902. His interests turned early toward marine invertebrates, and he came to the notice of William E. Ritter, the first Director of Scripps Institution of Oceanography. Esterly was with Ritter at the institution's beginning, as the San Diego Marine Biological Laboratory, in 1903 (Raitt and Moulton, 1967).

Esterly studied at Harvard under E. L. Mark, obtaining a Ph.D. in 1907, with a dissertation on copepods. Copepods remained the principal research field

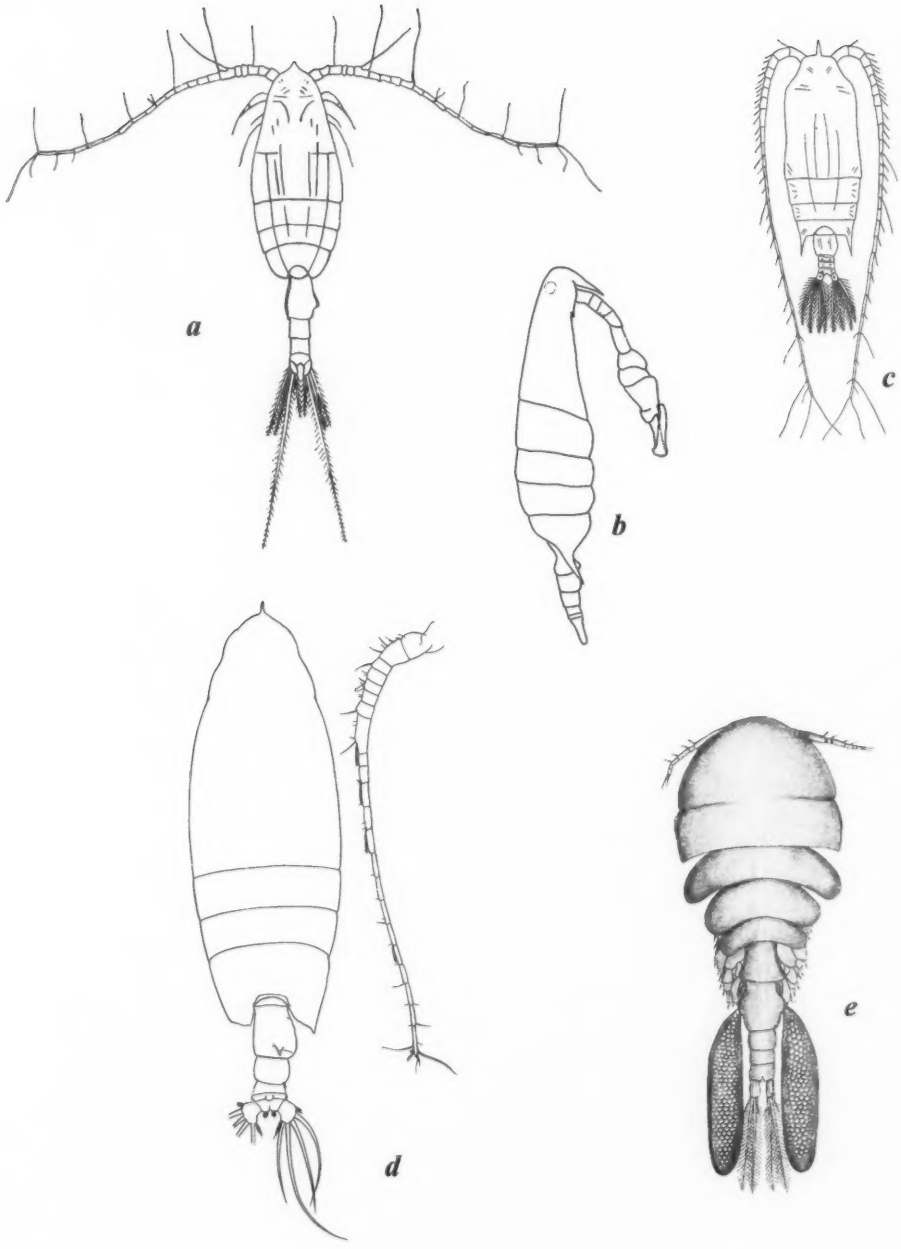
Figure 10.—Calvin Olin Esterly (1879–1928) (photograph ca. 1926, Occidental College, Los Angeles).

> ". . . to which Esterly set himself, and pursued for more than two decades without a moment of doubt about its worth, of swerving in purpose relative to it, or relaxation in pursuing it. . . . The history of marine biology does not furnish many instances of such a well-balanced combination of field, statistical work and laboratory experimentation as is furnished by the researches of Esterly on the Copepoda of the 'San Diego area' of the Pacific" (Ritter, 1928).

Returning from Harvard, Esterly was appointed Professor of Zoology at Occidental College in Los Angeles, a post he held for the rest of his short life. He was named to the "Non-Resident Staff" of Scripps Institution of Oceanography in 1910. Esterly only worked one full year at Scripps, but he was a virtual volunteer every summer otherwise. He died at La Jolla, Calif., in 1928.

H. B. Bigelow

It was fitting that copepods would have been collected by the multifaceted Henry Bryant Bigelow (1879–1967)



Some copepods from the *Albatross* collections: *Euchaeta concinna* (a) from Wilson (1950); *Paralabidocera amphitrites* (b) from Esterly (1924); *Gaetanus recticornis* (c) from Wilson (1950); *Scottocalanus infrequens* (d) from Tanaka (1969); *Pseudomolgus hawaiiensis* (e) from Wilson (1921);

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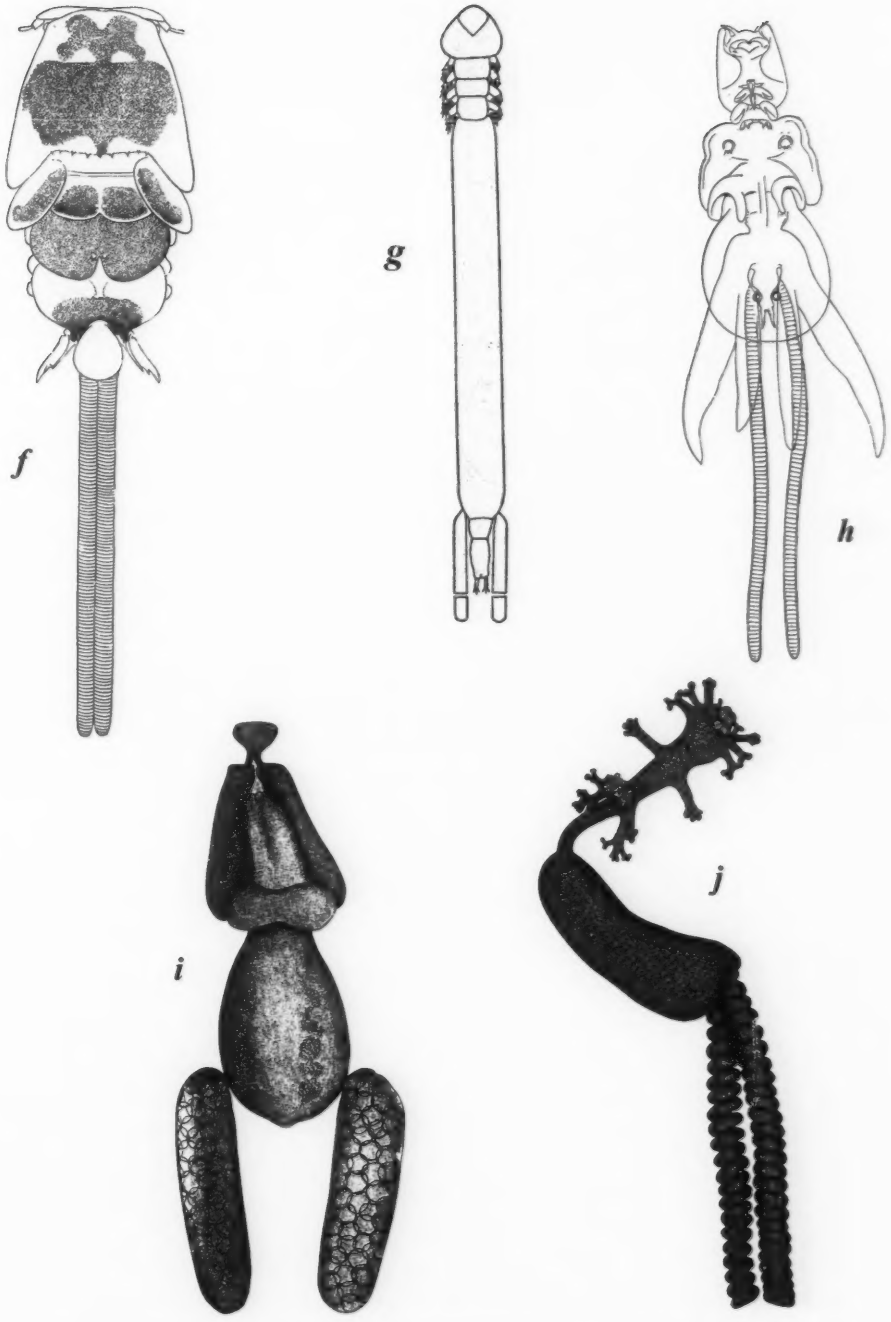

(Cont. from facing page) *Pandarus cranchi* (f) from Rathbun (1886); *Kroyerina elongata* (g) from Wilson (1944); *Lernanthropus pomatomi* (h) from Rathbun (1887); *Lernaeopoda bicauliculata* (i) from Wilson (1908); *Phrixocephalus cincinnatus* (j) from Wilson (1908). Figures a–d are of free-living, planktonic species; the others are of parasitic copepods.

on the last scientific cruise of the *Albatross*, from February into May 1920. The last *Albatross* station was occupied 19 May 1920, and Bigelow was there. No one was more entitled to write about these copepods than Bigelow. A 1906 Harvard Ph.D., he was a protégé of Alexander Agassiz, and had been on Agassiz's third *Albatross* cruise in 1905. Bigelow's earliest publications were on the systematics and distribution of planktonic coelenterates, which quickly gave him an international reputation. He contributed to this field for more than 30 years. To these studies, he soon added fishes, and ichthyology became his major field between 1925 and 1955. Remarkably, Bigelow added a third scientific discipline, that of oceanography and general plankton studies between 1914 and 1940. No one could accuse him of claiming harvests gathered by others; throughout his career, Bigelow was a preeminent field man. Associated with the Museum of Comparative Zoology, he became a principal spokesman for the development of oceanography in the United States, and he was the first director (1931–40) of the Woods Hole Oceanographic Institution (Anonymous, 1955). After that time, Bigelow was a Professor at Harvard until his death.

Bigelow incorporated the 1920 *Albatross* copepods into his definitive study of the plankton of the Gulf of Maine, begun as an "oceanographic and biologic survey" in 1912 (Bigelow, 1926). Most of the plankton for this study was collected from the *Fish Hawk* and the *Grampus* (90 feet), a Fish Commission schooner used from 1886 until 1918. Bigelow's tour de force was a review of a tremendous quantity of data on the horizontal and vertical distribution and seasonal abundance of phyto- and zooplankton, as well as chemistry and hydrography of the region. The plankton study complemented Bigelow's survey of the fishes of the same region.

The copepods were identified and enumerated by C. B. Wilson, and they were so acknowledged in the full title as well as the text. Copepods were the only group counted routinely in the samples from vertical hauls (including some *Albatross* collections). Bigelow discussed the problems of quantitative investigations for copepods and acknowledged the primary deficiencies in this study. There are better quantitative methods today. In Bigelow's survey, the sampling and the counting were standardized, so that at least relative abundances could be considered.

From the 1920 *Albatross* cruise, there were about 75 vertical and about 50 surface plankton hauls. Data tables showed stations, dates, depths, numbers of each species, and numbers of each species per square meter sea-surface.

Bigelow's (1926) report, "being ecologic and not systematic," included copepods as one of "the more important groups." Indeed, the specific copepod section comprised more than one-fourth of the total. Bigelow's summary on the food of copepods, and copepods as food for other organisms, is a classic in the field. Nearly 100 plankton copepod species are listed, with those from *Albatross* collections being the most diverse. Detailed information is provided for more than 50 species. Figures are given for the distributions and abundances of many 1920 *Albatross* species. There are good photographs of selected plankton samples, including many copepods from the *Albatross* collections.

Bigelow compared his information with what other studies there had been in the North Atlantic, by Canadian and European researchers. All in all, his report filled a large and detailed piece of the emerging picture of the biology of many important groups. For such a large area, this was probably the most detailed study of its kind, stressing repetitive sampling at the same stations, and it remains extremely useful.

After her active use, the *Albatross* was tied to the Bureau of Fisheries dock at Woods Hole until June 1924, when it was sold to a Boston firm (Hedgpeth, 1945). During this period, Paul S. Galtsoff was assigned to the now-dry-land but funded position of "*Albatross* Naturalist." Charles Fish continued the work on the seasonal distributions of Woods Hole copepods under Galtsoff's direction (Galtsoff, 1962). Fish's title was "General Assistant, U.S.F.S. *Albatross*," another now-dry-land assignment. If Fish had sampled from the tied-up *Albatross*, we would, I suppose, have been required to consider those copepods as a continuation of the *Albatross* tradition. However, the report from this work (Fish, 1925), except for a few new observations in Vineyard Sound, was based on samples collected entirely from the Woods Hole dock. During the *Albatross* years, the complementary reports on copepods by Wheeler (1900) and Sharpe (1911) should also be mentioned here only to record that they did not include *Albatross* material.

O. Tanaka

The copepods from the *Albatross* continued to be worked and reworked. Otohiko Tanaka (1902–1990), in 1969, published two reviews of *Albatross* copepods (Tanaka, 1969; Tanaka and Omori, 1969). Tanaka was a 1928 graduate of the Department of Fisheries of the Imperial University of Tokyo. In 1931, he joined the university as an assistant, already with his life-long interest in copepods. In 1934, Tanaka joined the staff of a private biological laboratory on the coast of the Izu Peninsula, where he began a long series of exceptional papers on the marine copepods of that region. This work was interrupted by World War II, when Tanaka served as an engineer officer in Manchuria.

After the war, Tanaka was appointed to the faculty of Kyushu University, where he renewed his study of the Izu copepods. He retired in 1965, whereupon he joined the Ocean Research Institute of the University of Tokyo. Tanaka (Fig. 11) was widely regarded for his nearly 50 papers on copepods, and kept up a lively correspondence and personal interest until his death (Nishida and Omori, 1991).

In a review of the genus *Euchirella* (Tanaka and Omori, 1969), advantage was taken of the large number of specimens available from Wilson's *Albatross* collections. A new species was described from samples off the west coast of South America, and 13 other species were redescribed. Seven of these had not been reported by Wilson (1950).

In the same year, Tanaka (1969) described or redescribed 13 other interesting copepod species that he had encountered in the review of *Euchirella* species

Figure 11.—Otohiko Tanaka (1902–1990) (photograph 1965, Kyushu University).

collected by the *Albatross*. Again, seven of the species had not been reported by Wilson (1950). These included three new species, one of which, *Wilsonidius alaskaensis*, represented a new deep-water genus named for Charles Branch Wilson.

With marine copepods, pelagic or parasitic, whether you are studying new or old genera or species, descriptions, or distributions, sooner or later you will encounter the *Albatross*. About 1,600 virtually untouched *Albatross* samples remain on the shelves of the Smithsonian Institution. As our coastal faunas are inadvertently homogenized and destroyed, these old samples take on new value. The century-old echoes from the *Albatross* have not yet faded away.

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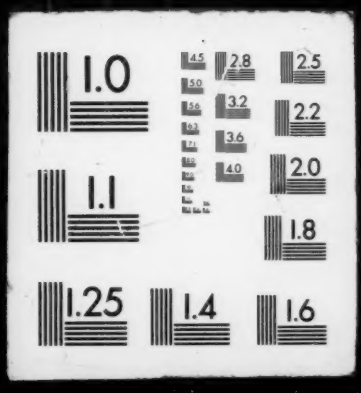
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